DESERT BIGHORN SHEEP HABITAT STATUS and COOPERATIVE ACTION PLAN in the LAS VEGAS DISTRICT

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A Cooperative Study by the

BUREAU OF LAND MANAGEMENT

and

NEVADA DEPARTMENT OF WILDLIFE

Las Vegas District Desert Bighorn Sheep Status Report

and

Cooperative Action Plan

Signed by DM and Department

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TABLE OF CONTENTS

Page

LIST OF TABLES

Number

INTRODUCTION

The desert bighorn sheep arrived in the Southwest approximately 10-15,000 years ago. In Nevada nearly every suitable mountain range probably supported bighorn. However, following the advent of white man into the Southwest, overshooting of the sheep and overgrazing of rangelands by livestock drastically reduced bighorn numbers. Within land administered by the Bureau of Land Management (BLM), Las Vegas District, 19 ranges still support desert bighorn at least seasonally. Nineteen other mountain ranges are potentially suitable for bighorn sheep, 15 of which are known to have supported bighorn prior to 1850.

In part, interest in this mountain dweller may be a result of its scarcity. The bighorn's inaccessibility due to the rugged terrain they inhabit, the obvious adaptability of desert bighorn which enabled them to survive in this harsh desert environment, and the massive horn development of the rams all contribute to the majestic character ascribed to this animal. Indians in the Southwest were impressed by the sheep as witnessed by the number of bighorn appearing in petroglyphs in Nevada. In recent years admiration for desert bighorn has resulted in the formation of various interest groups which have contributed time and money for habitat improvement projects and in the selection of the desert bighorn as the State Animal of Nevada.

The Bureau of Land Management's interest in these sheep and their habitat is further justified since it recently adopted the bighorn as a sensitive species that warrants special management consideration.

In the last ten years, the Nevada Department of Wildlife (NDW) has greatly improved its data base for managing desert bighorn. Improved helicopter surveys have increased the accuracy of population estimates. The Department has analyzed the status and trend of desert bighorn. A history of land use; a preliminary habitat survey including analysis of food, water and escape cover; and an analysis of bighorn surveys and count data have been presented for several mountain ranges occupied by desert bighorn.

Lanny Wilson (1968) made this pertinent statement regarding desert bighorn following his work in Utah: "Its value as a big game trophy is unsurpassed in North America and its aesthetic value because of its rarity is immeasurable. All possible steps to insure the welfare of these animals should be immediately undertaken." Due to the abundance of suitable habitat in southern Nevada administered by the Bureau of Land Management and the valuable data base on desert bighorn available for this area, the Las Vegas District has a tremendous opportunity to take these steps. Specifically, the objectives should include:

1) expanding desert bighorn numbers through transplant programs;
2) expanding desert bighorn numbers through quantitatively and qualitatively improving their habitat; and
3) insuring protection of present bighorn populations and the habitat they occupy.

This report presents a literature review on desert bighorn indicating what is known about this animal in the Southwest. The report includes a description of

the habitat and populations of desert bighorn, problems confronting desert bighorn, and the potentials for increasing sheep numbers and the quantity and quality of sheep habitat in the Las Vegas District. Finally, a cooperative action plan designed to reach the forementioned objectives has been developed by the Bureau of Land Management and Nevada Department of Wildlife and is proposed in this report.

LITERATURE REVIEW

Origin and Distribution

Bighorn sheep originated in Central Asia (Russo, 1956; Manville, 1971). During the late Pliocene or early Pleistocene, Ovis nivicola probably crossed the land bridge into North America. Rocky Mountain bighorn (Ovis canadensis) evolved as the sheep moved south along the Rockies, arriving in southwestern United States between 10,000 and 15,000 years ago (Cowan, 1940; Russo, 1956). At about this time, a dramatic climatic change from cool, moist to hot, dry conditions eliminated many members of the floral and faunal communities in the Southwest; but, the bighorn adapted (Bradley, 1967; McQuivey, 1978).

Due to the range of climatic conditions, bighorn physical measurements differ significantly; and, as a result, several subspecies of Rocky Mountain bighorn are recognized (Manville, 1971). However, the desert bighorn is actually an ecological rather than taxonomic entity. Ovis canadensis nelsoni, O. c. mexicana, and O. c. cremnobates are desert bighorn as are portions of the O. c. canadensis subspecies (Buechner, 1960; Manville, 1971). Las Vegas District (BLM) bighorn populations are representatives of O. c. nelsoni (Cowan, 1940; Buechner, 1960; McQuivey, 1978).

The broad distribution of bighorn has changed little from when white man first visited the Southwest in 1540 (Buechner, 1960). They are found in Arizona, California, Nevada, New Mexico, Texas, Utah, Mexico, and very restricted portions of Colorado and Wyoming (Monson, 1971).

Today, however, bighorn occupy one-tenth of the pristine mountain ranges that produced sheep 2,000 years ago (Yoakum, 1971). Sheep were subjected to poaching and unregulated hunting following immigration of white man to the Southwest. Domestic sheep (Ovis ovis) and cattle (Bos spp.) overgrazed rangelands and introduced new diseases to the bighorn. Miners habitated near springs, and bighorn waters were usurped for mining activities (Russo, 1956; Buechner, 1960; Yoakum, 1971).

Habitat

Regions occupied by the desert bighorn are characterized by very hot, dry summers and cool, dry winters. In Nevada, desert bighorn inhabit the Great Basin and Mohave deserts.

The Great Basin Desert covers the northern two-thirds of Nevada and is characterized by valleys alternating with mountain ranges oriented in a north-south direction (McQuivey, 1978). Elevations generally range from 2,000 to 8,000 feet (Hansen, 1971a).

A north-south orientation is characteristic of mountain ranges in the Mohave Desert, too. Elevation in this desert which covers southern Nevada range from 2,000 to 5,000 feet (Hansen, 1971a).

In ranges supporting bighorn in Nevada, there are three general vegetative types: desert shrub, woodland, and coniferous forest. Climatic differences across the state and changes in aspect influence the elevations at which these vegetation types occur.

In California, Nevada, and Utah blackbrush (Coleogyne ramosissima), sagebrush (Artemesia spp.) and juniper (Juniperus osteosperma)-pinyon (Pinus monophylla) communities within the shrub and woodland vegetation types are used extensively by bighorn (Wilson, 1968; Browning, 1971).

Open water is not abundant in much of the desert bighorn country. Some ranges contain springs or small perennial streams (Bradley, 1972). In ranges lacking these waters, natural catchments provide temporary open water (Hansen, 1971a).

Generally, bighorn occupy steep, rugged, and rocky escape terrain as well as hills and alluvial fans within one mile of escape cover. They prefer open terrain providing long viewing distances and use other terrain only when travelling between preferred habitats (Hansen, 1971a).

Gray desert soils and red desert soils occur at low elevations in the Great Basin and Mohave deserts, respectively, and usually have a high mineral concentration (Hansen, 1971a; McQuivey, 1978). Sandy loams are common at higher elevations. Although classed as poor and/or highly erosive, they are better drained and contain higher levels of organic matter than soils at lower elevations. Soils are shallow in riparian and cliff communities and usually lack distinct horizons while woodland and coniferous forest communities are generally supported by deeper soils with discernible horizons (Bradley, 1964).

Habitat Requirements

Any animal's environment must provide water, food, and cover if the animal is to survive; bighorn are no exception. In addition, bighorn habitat must offer bedding sites and lambing areas.

Water Requirements

Water is available to bighorn in the free or open state and in plants. Free water can be obtained from natural and man-made catchments, seeps, springs, and perennial streams. The weather, condition of forage, and activity of the bighorn all influence how often bighorn will visit water sources (Weaver, 1971). Lambs and ewes come to water every 10 to 15 days in the winter in Death Valley (Welles and Welles, 1961), although waterholes are abandoned during cool seasons on many of Nevada's bighorn ranges (Hansen, 1971a; McQuivey, 1978). Succulent vegetation can replace free water temporarily (Welles and Welles, 1961); but, summer temperatures dry up succulents. Also, as bighorn water requirements increase during the summer, a visit to a waterhole every three to five days during the hottest, driest periods is necessary (Koplin, 1960; Wilson, 1968). Turner (1973) found that desert bighorn must drink at least four percent of their body weight daily in the summer in California. As a result, bighorn activity is restricted to areas close to water in this season.

Free water requirements may be high during spring, too. Ewes may need free water when lactating in dry springs (Mahon, 1971).

Water consumption is variable and hard to observe (Hansen, 1971b). Consumption seems to vary with season, age, and location and may range from 0.82 to 2.50 gallons daily (Johnson, 1957; Koplin, 1960; Hansen, 1971a; Weaver, 1971).

The wary nature of wild sheep may prevent them from using free water in bighorn habitat (Hansen, 1971a). Presence of escape cover within several hundred yards of the waterhole, absence of other animals near the waterhole, and opportunity for unobstructed viewing of terrain in the vicinity of the waterhole may all be prerequisite to bighorn use (Hansen, 1971a; Mahon, 1971).

Food Requirements

Desert bighorn are capable of adjusting their diet to what is available (Brown et al, 1977). Observations in southern Nevada indicate they use 130 plant species from 89 genera (Deming, 1964).

Generally, new growth of grasses, forbs, and browse as well as buds and fruits are utilized during the growing season which begins between December and April (Hansen, 1960; Deming, 1964; Brown et al, 1977). In mountains with a wide range in elevation, bighorn may move to higher elevations as new growth progresses upward in the spring (Bradley, 1972). During summer and fall sheep can feed on dry grasses and browse unless local summer rains briefly provide new, lush vegetation (Deming, 1964; Browning, 1971).

Diets vary regionally and locally in the Southwest with changes in plant succulence and availability related to season, rain, and elevation (Barrett, 1964; Yoakum, 1966; Douglas and Norment, 1977). Many studies indicate grasses are preferred over forbs and browse (Bradley, 1964; Yoakum, 1969). Perennial grasses are common to all habitat types used by bighorn in the Southwest (Browning, 1971) and are preferred over annual grasses that are less palatable and nutritious when cured (Bradley, 1972; Hansen and Deming, 1971).

While grasses may be preferred to forbs and browse in all seasons (Deming, 1964), use of all three may vary seasonally. Forb use seems to be greatest in spring and/or summer (Barrett, 1964; Wilson, 1968; McQuivey, 1978). Browse use increases as grasses become less available (Leslie, 1977) and it may even receive more use than grasses if grasses are scarce (Russo, 1956). Conflicting reports by different researchers regarding seasonal preferences may be a result of working with small sample sizes, using different data collection methods, or sampling areas with differences in forage quality or quantity.

Cover Requirements

Escape cover is just as important as food and water to sheep. They rely on rugged terrain to avoid predators. All 4,000 bighorn observed by Nevada Department of Wildlife personnel over a three-year period were within one-half mile of broken terrain or mountainous habitat (McQuivey, 1978). Vegetation is not utilized unless it is close to mountainous terrain (Breyen, 1971).

In addition to escape cover, bedding sites and lambing areas are important habitat components. A daytime bed is often in a shaded area providing an unobstructed view of at least a portion of the surrounding terrain (Simmons and Hansen, 1971; Heimer, 1973). Night beds generally are found in areas with rough terrain covered with small rock fragments so bighorn will be alerted to the approach of other animals (Hansen, 1971a). Sites are often along ridge tops that allow quick access to escape cover.

Lambing usually occurs in rugged, precipitous terrain; areas with caves and overhangs are preferred (McQuivey, 1978; Russo, 1956). Elevations and locations vary year to year (Hansen and Deming, 1971; Hansen, 1971b; Light and Weaver, 1973; Leslie, 1977). Green vegetation that will supply the protein and milk production requirements of lactating ewes must be available close to the rugged terrain (Hansen and Deming, 1971). Free water is not needed by the ewes if green grass and succulents are available (Wilson, 1968). However, lambing areas will not be used if climatic conditions reduce the abundance of succulents (Welles and Welles, 1961).

Home Range and Movements

Bighorn home range size varies with temperature, forage condition, and water availability (Leslie, 1977; McQuivey, 1978). In general, they are smaller in size in summer since bighorn water requirements are greater at this time (Welles and Welles, 1961; McQuivey, 1978).

If summer forage conditions are favorable, bighorn will not wander far from the waterholes; but, summer ranges are expanded when forage is scarce and temperatures are moderate (Leslie, 1977). Summer home ranges of ewes are described with radii of .75 mile or less in California and Arizona and are decribed as being within one-half to one mile of water in southeastern Utah (Wilson, 1968; Blong and Pollard, 1968; Simmons, 1971). In addition, summer ranges expand when rains fill natural catchments enabling the sheep to leave waterholes and forage in areas usually inaccessible due to water shortage (Wilson, 1968).

Cool temperatures and slower evaporation rates reduce water demands of bighorn in winter. A close association with waterholes is not necessary in this season.

Dispersal into new territory is uncommon in bighorn but seasonal shifts in elevation and between ranges do occur (Bradley, 1972; Light and Weaver, 1973; McQuivey, 1978).

Snow cover at higher elevations force some populations to winter at low elevations. The sheep move upward through the summer as plants develop and return to lower elevations in winter. Sheep movements between ranges or portions of ranges covering 18 to 40 miles often are in response to the need for water which is not available in some areas in summer (McQuivey, 1978).

Social and Reproductive Behavior

Bighorn are usually found in small groups. Adult rams associate with adult rams; and, adult ewes are found with lambs, yearlings, and other adult ewes (Russo, 1956;

Simmons, 1971). Group size is variable and seems to be influenced by forage availability, season, and population density (Welles and Welles, 1961; Simmons, 1971; Leslie, 1977; McQuivey, 1978). Group size decreases as forage availability decreases.

During the breeding season rams disperse and begin mingling with ewes. Wilson (1968) speculated that not all mature ewes are always bred. If so, this may be due to the short period of receptivity of the ewes and low population densities that lessen the chance of ewe-ram encounters.

The breeding season occurs during the hottest, driest time of the year, coinciding with relatively high concentrations of ewes near water (McQuivey, 1978). It begins and ends earlier in the southern part of the desert bighorn range (Russo, 1956; Wilson, 1968; Simmons, 1971). Rut occurs from August through November in Nevada (McQuivey, 1978).

Generally, the breeding seasons and lambing seasons vary year to year and cover several months (Russo, 1956). The spread in delivery dates enhances overall lamb survival since brief cool, moist weather conditions can adversely affect natality (Hansen, 1971b). Gestation lasts about six months (Hansen and Deming, 1971).

Population Dynamics

Desert bighorn have evolved a strategy for survival which includes several years of reproductive activity, low numbers of offspring per ewe each year, and a relatively long program of parental care. In Nevada, the average yearling ram is expected to live 4.7 years; and, some rams are known to live more than 13 years (McQuivey, 1978). Assuming the life expectancy of ewes is similar, it is obvious that bighorn reproductive activity continues over several years. Twinning in bighorn is rare. One lamb per pregnant ewe is normal (McQuivey, 1978). Newborn sheep nurse for five to six months (Hansen and Deming, 1971) and remain in the company of adult ewes for as much as 18 months (Leslie, 1977).

Productivity rates based on spring surveys are often underestimated because long breeding seasons inevitably cause biologists to miss some lambs that are born and die early (Hansen, 1971b). Also, immature ewes are invariably included in counts of adult ewes. Fall survival ranges from 19 to 49 lambs per 100 ewes (Hansen, 1967; Wilson, 1968; McQuivey, 1978).

Limiting Factors

Competition

Bighorn require food, water, and escape cover to survive. Livestock, other free-roaming ungulates, and man compete with the sheep for these habitat requirements.

Livestock are repeatedly blamed for bighorn reductions in the late 1800's (Russo, 1956; Buechner, 1960; Jones, 1971). Overgrazing by livestock results in range

deterioration including a decrease in grasses, the preferred forage of bighorn, and an increase in browse (Wilson, 1968; McQuivey, 1978).

Critical competition occurs for forage and water around waterholes (Jones, 1971). Seasonal removal of cattle from waterholes used by bighorn in the summer will not eliminate this competition, however, if cattle have already consumed the cured and new vegetation during the preceding winter and spring (Russo, 1956).

Domestic sheep and bighorn have similar food habits (Jones, 1971). Therefore, grazing by an excessive number of domestic sheep may seriously reduce forage available to bighorn and thereby stress the bighorn. This may explain to some degree the absence of bighorn sheep noted by McQuivey (1978) in areas grazed by domestic sheep in Nevada.

Overgrazing by horses (Equus caballus) in sheep habitat during the growing season causes range deterioration, too (Buechner, 1960). Grass cover decreases and brush cover increases (Wilson, 1968).

Burros (Equus asinus), like livestock, destroy vegetation by overgrazing (Welles and Welles, 1961; Jones, 1971; Douglas and Norment, 1977). They consume food enroute to and around waterholes where they concentrate during hot, dry weather (Seegmiller, 1977). Results of one study indicate burros use 64 percent of the plant species used by bighorn. Excessive numbers of burros may stress lambs since both show a preference for forbs (Seegmiller, 1977). In addition, intrusion of burros into bighorn range may lead to a decrease in use of the water sources by sheep (Weaver, 1973).

Competition for food with mule deer (Odocoileus hemionus) is a function of range condition and season. Since mule deer are primarily browsers (Yoakum, 1966) and bighorn prefer grasses, ranges with sufficient quantities of browse and grass should supply both species with needed forage. However, forage conflicts are increased when there is a scarcity of preferred plants. In addition, seasonal competition for browse and for forbs and grasses may occur in the winter and spring respectively. Mule deer and bighorn do use the same water in some areas, too.

Man is responsible for many factors limiting bighorn populations. In addition to introducing several animals to the Southwest that compete with bighorn, man competes for water and shelter, too.

As miners and ranchers moved into the Southwest in the 1800's, bighorn began to lose their habitat. Water was diverted for livestock watering, mining activities, and man's personal needs (Graham, 1971; Yoakum, 1971). As a result, bighorn often no longer used the water sources. In addition, forage was depleted due to livestock grazing. A portion of bighorn range was eliminated from use.

Today, man's activities still restrict bighorn use of portions of their range. Fences can restrict movements. Roads and picnic areas near or within sight of watering areas, lambing areas, or other suitable bighorn habitat can and do restrict or eliminate bighorn activities in these areas (Graham, 1971; Light and Weaver, 1973; Jorgenson, 1974; McQuivey, 1978).

Frequent, erratic human activity in bighorn habitat may disrupt sheep activity and force sheep out of areas important to them (Graham, 1971). Powerline corridors increase human activity and provide avenues for increased disturbance of bighorn (McQuivey, 1978). Highways that transect migration routes may restrict movements thereby removing a portion of suitable range from use.

Parasites and Disease

Bighorn carry several parasites including ticks and tapeworms (Russo, 1956; Allen, 1971). Generally, the observed parasite levels are not detrimental; but, moderate parasite loads can be damaging if sheep are crowded, on a low nutritional plane, exposed to livestock, or exposed to stressful climatic conditions (Russo, 1956; Allen, 1971). Scabies, a mite probably introduced by domestic sheep, decimated desert bighorn in California in the late 1800's (Buechner, 1960).

Pneumonia seems to be the primary cause of lamb mortality in Nevada (Taylor, 1976). Dietary deficiencies or lungworm may stress the lambs making them susceptible to pneumonia (Johnson, 1957; Taylor, 1976).

Predation and Other Limiting Factors

In general, predation is not considered a significant limiting factor in free-roaming populations; but, Golden Eagles (Aquila chrysaetos), coyotes (Canis latrans) bobcats (Lynx rufus), and mountain lions (Felis concolor) may prey on lambs (Russo, 1956; Buechner, 1960; Hansen, 1971a; McQuivey, 1978).

Long droughts which create poor forage and water conditions can result in bighorn deaths, although such prolonged droughts are rare (Monson, 1960; Allen, 1971).

Resource Management

Habitat Evaluation

Bighorn habitat evaluation is generally very subjective. Food, water, and escape cover requirements are qualitatively analyzed. The qualitative approach involves assigning value points to the environmental factors which influence bighorn use patterns. Points assigned to an area are totalled to provide a classification for the area ranging from not important to vital for bighorn (Hansen, 1971d). This basic approach and several modifications have been used throughout the Southwest for evaluating bighorn habitat.

Bighorn management would be enhanced if it was known how the bighorn habitat requirements including food, water, and escape cover are distributed in relation to topography and elevation and how bighorn respond to different interrelationships of food, water, and escape cover (Bradley, 1972). Obtaining this information requires quantitative habitat evaluation. Some work has been done in this area in Nevada. Quantitative factors have been used to measure vegetative cover, ruggedness of terrain, distance to water, and intensity of sheep use when analyzing bighorn habitat in some ranges in Nevada in an effort to eliminate subjectivity (Ferrier and Bradley, 1970; Breyen, 1971; Bradley, 1972).

Habitat Management

Habitat development enhances population growth. Protecting and developing bighorn habitat includes bighorn habitat development and improvement, livestock management, horse and burro management, recreation management, land acquisition, restricted corridor and communication sites development, and restricted road development and mining activity (Hinkes, 1978). Water development in strategic locations increases the amount of forage and escape cover available for the desert sheep. Water development can involve rehabilitating old springs, increasing water flows at existing springs, drilling wells, and developing man-made water catchments with storage facilities (Halloran and Deming, 1958; Welles and Welles, 1961; Mahon, 1971; Graf, 1971; McQuivey, 1978). If competition from burros or livestock is anticipated, fences can be constructed to insure that the water is available for the sheep (Halloran and Deming, 1958; Helvie, 1971; Cleary, 1973).

Vegetative manipulation includes elimination of competition for forage and transforming the plant community to an earlier successional stage. Eliminating competitors involves fencing programs, restricting grazing of other herebivores, and eliminating burros, horses, and goats (Russo, 1956; Graf, 1971; McQuivey, 1978).

Chaining, controlled burns, and selective control of wildfires can be used to alter plant succession and can be followed by seeding preferred species. (Graf, 1971; Reese and Baxter, 1973). These methods are applicable in pinyon-juniper communities where reducing the overstory cover will allow an increase in grass cover.

Manipulating public use involves setting restrictions on recreational and industrial activities. It has been proposed that hiking, camping, horseback riding, off-road vehicle use, target shooting, and skiing activities should not be allowed to harrass the sheep, destroy their habitat, or eliminate critical portions of their habitat (Light and Weaver, 1973; Reese and Baxter, 1973).

Bighorn Management

Population management involves regulating numbers of animals. Information on bighorn densities, numbers, and population dynamics is important. However, the inaccessibility of bighorn habitat and low densities common in desert bighorn populations make it difficult to obtain the data. Counts of bighorn at waterholes, line transects through bighorn habitat, lambing season lamb and ewe counts, pellet group counts, random observations, and aerial surveys have all been used to obtain these data (McQuivey, 1978).

The numbers of bighorn sheep can be increased by vegetative manipulations as previously mentioned and by transplanting bighorn (Browning, 1971; Yoakum, 1971). Establishing bighorn on historic range or other suitable range requires consideration of potential disease problems, public attitudes, methods to be used, expected distribution, water and forage supplies, and future land management plans (Hansen, 1971e; Weaver, 1971). Transplants with bands of 20 or less sheep have been successful (Hansen, 1971c). Trapping at waterholes and capture with drugs administered with dart guns are common capture techniques (Hansen, 1971e, Douglas and Norment, 1977). Various drugs can be administered to help the sheep survive the stress of handling (Spraker, 1977). Captured sheep are then released into the new range (Douglas and Norment, 1977) or released into an enclosure on the new range (McCutcheon, 1977).

Unfortunately, although the enclosure may prevent sheep from immediately leaving new habitat before they have a chance to adapt to different vegetation types, predators may prey upon confined sheep. The sheep may suffer from malnutrition if the vegetation in the enclosure cannot support them.

BACKGROUND INFORMATION

Description of the Area

Geographical Location

The Las Vegas District is located in the southern tip of Nevada (Map One). The Sierra Nevada Range to the west intercepts moisture bearing clouds; and, as a result, the desert climate and vegetation are common throughout the district. The northern third of the district is within the Great Basin Desert; the remainder lies within the hotter, drier Mohave Desert.

Climate

In the north, most precipitation falls in the spring and fall; snow is common (Hansen, 1971a; Bradley, 1972). Annual precipitation ranges from six to 10 inches In the south, most moisture falls in winter and spring with snow occurring at high elevations. Scattered cloudbursts and long droughts are characteristics of the region (U.S.D.I., 1973a-b). Precipitation usually does not exceed five inches yearly (Hansen, 1971a). Evaporation exceeds 100 inches and 50 inches yearly at low and high elevations, respectively (U.S.D.I., 1978).

Temperatures throughout the district can range from well below freezing to greater then 100°F at lower elevation. In the north daily average temperatures range from 29-39°F in January and from 70-80°F in July. Southern daily averages range from 32-50°F in January and average over 86°F in July with daily highs exceeding 100°F (Jaeger, 1957). Temperatures at higher elevation in the mountain ranges may be 10 to 20°F cooler; but, in general, the low precipitation rates, high evaporation rates, and high temperatures mean that little water is available to bighorn. The hot, dry season generally includes May through September. The cool season include October through April.

Topography

The topography of the district can be described as a series of narrow north-south oriented, rugged mountain ranges separated by valleys. Thirty-nine ranges are present within the district (Map One). Most elevations on valley floors range from 2,000 to 5,000 feet and most mountain elevations range from 2,000 to 10,000 feet. Alluvial aprons are common at the base of the mountains. Alkali falts are found in basins with closed drainages (U.S.D.I., 1975a).

Soils

Parent material for soil formation within the district is quite variable. Metamorphic, igneous, volcanic, and sedimentary bed rock are all present (Longwell et al, 1965; Albers and Stewart, 1972).

Soils within the mountain ranges are generally immature and shallow. Rocky, gravelly coarse textured soils predominate. Gravelly, cobbly, stony, sandy, and silty loams are common in the surface layer (U.S.D.A., 1977). Although rooting depth can exceed 12 inches, surface run-off is medium to rapid (U.S.D.A., 1977). The soils are alkaline and calcareous, and a hardpan layer often develops just below the surface due to leaching in the alluvial fan and valley floor soils (U.S.D.A., 1977).

Vegetation Types

Vegetation types are closely associated with moisture conditions. Precipitation increases with elevation and the vegetation reflects this gradient. Annuals predominate at low elevations so forage production and ground cover in dry years can be minimal or non-existant. Perennial grasses are more common in higher elevations of creosote bush (Larrea divaricata) and in blackbrush and sagebrush communities (Ferrier and Bradley, 1970; Bradley, 1972). Woody plant cover increases as the elevation increases.

In Nevada, desert shrub, woodland, coniferous forest, and alpine tundra vegetation types are dominant. Generally desert shrub is present up to 6,000 feet, woodland occurs from 5,000 to 8,000 feet, coniferous forest is found from 7,500 to 11,500 feet, and alpine tundra may be established above 10,000 feet (Bradley, 1964). For management purposes, the plant communities must be delineated within each type.

According to Bradley (1964) the desert shrub type contains four communities. The creosote bush community covers must of the terrain below 5,200 feet (McQuivey, 1978). Annuals are prevalent; vegetative density and composition depends upon the amount of seasonal precipitation. The blackbrush community occurs between 4,200 and 6,000 feet. Grasses are common on washes and alluvial fans. Saltbrush (Atriplex confertifolia) communities are found on playas at 2,800 and 5,000 feet. Little herbaceous vegetation is present. Riparian communities are developed along desert washes from 2,600 to 5,000 feet. The vegetation is similar to adjacent communities although perennial grasses may be more abundant.

The sagebrush--grass vegetative type is sandwiched between desert shrub and woodland types in some areas, especially in the Great Basin region. It occurs between 4,500 and 6,000 feet in central Nevada and occasionally above 5,000 feet in southern Nevada. Sagebrush predominates although the abundance of perennial grasses is greater than at lower elevations (McQuivey, 1978).

The woodland vegetative type contains pinyon-juniper and riparian-cliff communities (Bradley, 1964). Dominate vegetation in the pinyon-juniper communities include Utah juniper, pinyon pine, and sagebrush. The understory is very different from that of shrub communities except many grasses are common to both types. Elevations range from 6,000 to 7,300 feet. The riparian cliff community occurs from 5,000 to 8,000 feet along washes and canyon sides. Desert shrubs occur at lower elevations; luxuriant shrubs are found higher.

The coniferous forest type contains two communities. The fir-pine community, mostly white fir (Abies concolor) and ponderosa pine (Pinus ponderosa), is established at 7,500 to 9,000 feet with an understory similar to that of pinyon-juniper community (Bradley, 1964). The bristlecone pine (Pinus aristata) community contains less herbaceous vegetation and occurs on very steep slopes from 9,000 to 11,500 feet. Limber pine (Pinus flexilus), white fir, bristlecone pine, and common juniper (Juniperus communis) are prominent.

The alpine tundra type is a pseudo-alpine community. Found above 10,000 feet on western exposures, perennial herbs and grasses and small woody plants are present (McQuivey, 1978).

Forage production on bighorn ranges is variable from year to year and seasonally. Annuals are an important source of nutrition for bighorn; but, they depend upon sufficient moisture conditions and may not be present due to drought conditions (Russo, 1956). Portions of sheep habitat may be missed by summer cloudbursts and fail to produce seasonally nutritious forage (Hansen, 1971a).

Sparse vegetation is characteristic of most desert ranges. Total vegetative cover in the Eldorado Mountains of southern Nevada generally increases with elevation with total cover averaging 3.36 percent between 2,000 and 2,500 feet and 5.93 percent between 3,500 and 4,000 feet (Breyen, 1971). Forage preferences make usable cover even more sparse than actual cover.

As a result, bighorn may have to cover large areas to meet forage needs. They should have a variety of plant communities that provide a wide variety of forage species to enhance survival during dry conditions (Hansen, 1971a).

Water Availability

The amount of water available to bighorn is limited. Springs are found in the mountain ranges and valley floors and are recharged with mountain precipitation and underflows in bedrock (U.S.D.I., 1975a). However, the springs are not evenly distributed and the flows fluctuate seasonally and historically. Natural and man-made catchments provide the only free water to wildlife in dry ranges.

Since bighorn will not use forage away from water and may overutilize vegetation near water during droughts (Weaver, 1971; Hansen, 1971a; Bradley, 1972), water developments are needed to distribute the sheep across the available range and to enhance the use of available forage.

Bighorn Population Description

Population Estimate and Distribution

Although there is no population estimate available for the 1700's, it is obvious that bighorn numbers were greatest prior to the influx of people from the east (Yoakum, 1971). In 1960, an estimated 6,700 - 8,100 *O. c. nelsoni* and *O. c. mexicana* inhabited the Southwest, 1,500 - 2,000 in Nevada (Beuchner, 1960). Nevada's bighorn population was set at 2,475 in 1969 (Monson, 1971). This was 18 percent of the North American population and 25 percent of the United States population. Forty-eight percent of this population used ranges in the Las Vegas District.

Following the implementation of improved censusing techniques over a large portion of the state's sheep habitat, Nevada's bighorn population estimate was again revised upward and set at 4,269 in 1976 (McQuivey, 1978). Fifty-three percent of these sheep utilize lands administered by the Las Vegas District. Table 1 gives population estimates for each of 19 mountain ranges that support bighorn sheep in the Las Vegas District.

TABLE 1

Desert Bighorn Population Estimates and Square Miles of Bighorn Habitat in the Las Vegas District

Range	Pop Est[1]	Current	Crucial[2]	Historical[3]	Potential[3]	Total
Monte Cristo	70	59.4	10.8(18)	60.4		119.8
Lone Mountain	146	28.7	27.4(95)	44.8		73.5
Silver Peak	113	124.4	68.1(55)	152.5		276.9
Stonewall	8	4.6	2.9(63)	32.2		36.8
Spring	162	116.9	47.8(41)	425.6		542.5
So.Spring-Bird Sp.	70	109.4	16.2(15)	63.2		172.6
McCullough	158	164.8	29.8(18)	14.3		179.1
N.York-Castle	25	29.0	19.5(67)	5.2		34.2
Highland	50	32.6	19.6(60)			32.6
Eldorado	410	75.4	19.6(26)	13.4		88.8
River	210	19.5				19.5
Virgin Mtns.	11	5.8	2.9(50)	98.3		104.1
Muddy	122	93.5	5.9(06)			93.5
Arrow Canyon	104	71.2				71.2
Mormon	385	123.1	32.2(26)	13.8		136.9
Meadow Valley	155	108.2	7.0(06)	16.2		124.4
Delamar	50	41.1		339.4		380.5
Pahranagat	a	19.4		120.5		139.9
Palmetto-Magruder				145.2		145.2
Montezuma				59.1		59.1
Goldfield				27.9		27.9
Amargosa				46.9		46.9
Sawtooth				24.2		24.2
Johnnie				49.3		49.3
Sheep-Roach				34.0		34.0
Newberry				41.1		41.1
Sunrise				30.3		30.3
Gold Butte	10	2.0	1.7(85)	164.1		166.1
N. Muddy				58.3		58.3
Dry Lake				37.0		37.0
Pahroc				93.3		93.3
Hiko				35.6		35.6
Groom				87.8		87.8
Gold Mountain					169.2	169.2
Bare					41.1	41.1
Specter					44.1	44.1
Clover					121.2	121.2
Tempiute					23.3	23.3
Belted					84.8	84.8
TOTAL	2265	1229.0	311.2	2333.9	463.7	4046.6
PERCENT OF TOTAL		30.3	7.7	57.7	12.0	100.0

1 - McQuivey, 1978
2 - (#)=percent of current habitat
3 - unoccupied
a - number undetermined

Historically, bighorn utilized 33 ranges (McQuivey, 1978) or 3,562.6 square miles within the district (Map Two). This and following area figures include bighorn habitat administered by BLM but do not include the sheep habitat in the White, Spotted, Pintwater, Desert, Sheep, Las Vegas, and Black Mountain ranges since they are entirely, or nearly so, under the administration of other federal agencies. The figures do not include the portions of bighorn habitat administered by other federal agencies in the Amargosa, Sawtooth, Newberry, Eldorado, River, and Gold Butte ranges.

Today, desert bighorn utilize 1,220.0 square miles of habitat in 19 ranges in the Las Vegas District (Table 1). This is 30.3 percent of the 4,046.6 square miles of suitable habitat distributed over 39 mountain ranges in the district.

The quantity of crucial habitat, areas within two miles of yearlong water sources in bighorn habitat, indicates the degree to which the habitat is well watered. These areas are delineated on Map Two and listed in Table 1. The BLM does not manage any crucial habitat in the River Mountains. Crucial habitat has not been identified, yet, in the Delamar and Pahranagat ranges although it may exist. No known yearlong water is available to sheep in the Arrow Canyon Range.

Crucial migration routes between ranges include the Pahranagat-Desert, Delamar-Sheep, Delamar-Meadow Valley, Arrow Canyon-Las Vegas, Arrow Canyon-Meadow Valley, Muddy-Black, Spring-Bird Spring, and South Spring-Clark Mountain (CA) routes. Current bighorn habitat will become inaccessible to bighorn if man's activities prevent sheep movements along these routes. Migration routes are shown on Map Two.

Fourteen of 19 ranges used by bighorn currently support sheep yearlong. However, except for Lone Mountain, portions of these ranges contain no known springs or have springs which flow only during the cool, wet season. The sheep need free water when the vegetation dries up and the temperatures increase. For this reason, bighorn cannot use these waterless portions in the hot, dry season except briefly after thundershowers using water available in natural and man-made catchments. Generally, their movements are restricted to areas within two miles of permanent, available water during this season (Leslie and Douglas, 1979).

The Arrow Canyon Range has no known yearlong water available for bighorn; and, generally, is utilized only in the cool, wet season when the sheep are less dependent on free water sources. The sheep migrate between this range and others with permanent water seasonally.

The extent to which the remaining four ranges are utilized is uncertain. Bighorn have been observed in the Delamar and Pahranagat ranges in the fall and/or winter but may support sheep yearlong. Sheep were transplanted to the Virgin Mountains in June, 1979. Some of those sheep have moved into the Gold Butte Range. The future distribution and movement of these sheep in these two ranges are uncertain. Map Two indicates seasonal use areas, crucial summer habitat around permanent water, and migration routes used by bighorn.

There are 2,333.9 square miles of historical habitat in 29 ranges in the district that are not being utilized by desert sheep. This is equivalent to 57.7 percent

of the bighorn habitat in the district. Six ranges contain 483.7 square miles of potential habitat that may not have supported sheep historically. These areas are delineated on Map Two and listed in Table 1.

Population Dynamics and Trend

McQuivey (1978) indicated that Nevada's ewes produce only one lamb yearly. Since 1969, the fall ewe-lamb ratio has fluctuated from 100:19 to 100:49, averaging 100:32. Ram-ewe ratios average 60:100. The mortality rate is highest for the zero year class. Rates are lower and constant after the first year.

Assuming equal sex ratios at birth and equal ram and ewe lamb mortality, 26 lambs must survive for every 100 ewes if the mountain range populations are to remain stable. Production fluctuates around this 26 lamb minimum yearly on each range. While some populations are increasing or decreasing on a short term basis, the district-wide population is stable on a long term basis (McQuivey, 1978). Increases in conflicting land uses could lead to a long term decrease in bighorn numbers.

Past, Current, and Potential Conflicting Land Uses

Conflicts between bighorn and other resource users in sheep habitat are difficult to evaluate quantitatively. The amount of area other resource users encompass and the degree to which they affect bighorn vary in each range. As a result, land use was analyzed subjectively.

Grazing and Watering by Livestock, Horses, and Burros

Many factors were considered when analyzing livestock-bighorn competition since livestock were often responsible for the major problems confronting the bighorn sheep in the district. Although forage in rugged escape terrain is not accessible to cattle, bighorn and cattle compete for forage on gentle slopes and in washes adjacent to escape cover and water sources. Competition for forage including galleta grass (Hilaria jamesii), Indian ricegrass (Oryzopsis hymenoides), salina wildrye (Elymus salina), cheatgrass (Bromus tectorum), blackbrush and green-molly summer cypress (Kochia americana) (Wilson, 1968) is manifested by bighorn population densities that are lower in areas with livestock grazing than in areas without livestock grazing (McQuivey, 1978).

Livestock competition is most severe during the dry, hot season (May through September) when both cattle and bighorn center their activities around permanent water sources that are essential to both species. Forage in the vicinity of water is of prime importance to both grazers at this time.

Therefore, the first step in analyzing current livestock-bighorn conflicts involved consideration of the location of dry season livestock concentration areas. These areas are delineated on Map Three. Conflicts are most severe where these areas overlap with crucial bighorn habitat.

In addition, the amount of crucial habitat within each range and the number of bighorn using that habitat were considered.

Range suitability criteria that will be used when allocating forage for livestock include a stipulation which prohibits the allocation of forage to livestock on

areas with 50 percent or greater slopes. So, to more accurately define the extent of dry season livestock conflicts, the amount of crucial habitat with less than a 5 percent slope was determined.

Competition for water during the dry season warrants consideration, too. Conflicts are likely to occur for water if the water source is accessible to livestock and within one-mile of escape cover in bighorn habitat. Sheep may be reluctant to approach water sources when cattle are nearby; and, as a result, livestock concentrations near water may reduce bighorn use (Wilson, 1968). Some water source are inaccessible to livestock; so, the operator has piped the water to the livestock, eliminating all or most of the water at the source for bighorn. Other water sources are corralled, preventing sheep use yearlong.

To evaluate the competition for water, the number of permanent waters used by bighorn in critical habitat and the number of those waters also used by livestock were determined. The Nevada Department of Wildlife provided information on permanent waters used by the sheep and it was assumed that waters in areas with les than a 50 percent slope were used by livestock.

The number of livestock licensed to graze in bighorn ranges and the dates when grazing occurs are obviously important. As mentioned earlier, dry season conflicts are most severe since the animals are concentrated near permanent water sources. During the relatively cool season (October through April) cattle and domestic sheep can utilize lush vegetation in nearly any area accessible to them on the ranges.

The type of livestock grazing the range is important, too. Cattle are restricted from using some areas due to rugged terrain, but domestic sheep are less restricted McQuivey (1978) noted that no bighorn exist in areas presently grazed by sheep in Nevada. In the Las Vegas District, domestic sheep trail in historical bighorn habitat in the Virgin Mountains. They graze in very small portions of the Newberry and Silver Peak ranges and in potential habitat in the Tempiute Range.

Therefore, the number, type, and dates of livestock grazing since 1975 were considered in each current bighorn range. Numbers of cattle and seasons-of-use varied seasonally and annually in each range. If an allotment covered a portion of several sheep ranges, all the cattle in the allotment were assumed to be present in each range. The numbers provided an idea of the maximum amount of competition for food and water that is possible on each sheep range seasonally.

If should be remembered that livestock and bighorn need not be in the same area in the same season to compete for forage. Livestock that graze a crucial area during the growing season can deplete the forage supply before the operator moves them elsewhere leaving little forage for bighorn in the dry season when they must concentrate their activities near springs.

Changes in grazing allocations, seasons-of-use, and types of livestock licensed in sheep ranges in the Caliente Planning Unit have been proposed (U.S.D.I., 1979). The impact of these changes were considered, too.

The impact of livestock use is quite variable. The degree to which each factor considered reflects conflicts and the impact of each factor considered in rating livestock conflicts are different in each range. A subjective analysis of these

factors is necessary at this time. The conflict rating applied to livestock use in each range will be reevaluated in the field during Habitat Management Plan (HMP) development.

For the purpose of this report, livestock conflicts on each current sheep range have been rated as serious, moderate, low, or non-existent. The analysis indicates serious conflicts occur in seven current habitats (Table 2).

Livestock-bighorn conflicts were considered in a similar manner in historical and potential bighorn ranges. Known livestock concentration areas; number, types, and dates of livestock grazing in bighorn ranges; and proposed changes in livestock grazing in bighorn ranges were considered.

All waters were assumed to be permanent unless known to be dry to seasonal, and crucial areas were assumed to exist around all permanent waters. The number of permanent waters in the potential crucial habitat was also considered.

Based on a subjective consideration of these factors, livestock conflicts on each historical and potential sheep range have been rated as serious, moderate, low or non-existent. Analysis indicates serious conflicts could develop if sheep were introduced in 12 of 29 historical and two of six potential bighorn habitats. (Table 3). These ratings will be reevaluated in the field during HMP development.

In general, livestock-bighorn conflicts are likely to develop in bighorn habitat wherever livestock numbers are increased or livestock waters are developed. Potential conflicts are likely to be realized in the Stonewall and Goldfield ranges where livestock grazing has been temporarily discontinued until an allotment fenceline is constructed. Heavy livestock use will resume following construction. Conflicts may increase in the South Spring-Bird Spring Range when the operator finishes his range improvements and resumes livestock grazing.

Conflicts are likely to change during the next few years in the Caliente Planning Unit due to changes in animal unit month (A.U.M.) allocations and in seasons-of-use (U.S.D.I., 1979). Summer use will be eliminated in current sheep habitat in the Meadow Valley Range, but the available A.U.M.'s will increase for the winter months. Increased use is proposed in current habitat in the Mormon Range. Livestock use in historical or potential habitat should increase in the Delamar, Hiko, Pahranagat and Tempiute ranges and should decrease in historical and potential habitat in the Mormon, Meadow Valley, Pahroc, Groom, and Clover ranges.

Horses and burros began to roam the range as soon as the white man arrived in the Southwest. Today, in the Las Vegas District, these animals utilize 33 current, historical, and potential bighorn habitats. This information was obtained from Bureau of Land Management inventories since 1975 and from the Nevada Department of Wildlife. Map Four identifies the areas within bighorn habitat utilized by horses and burros.

Analysis of the severity of free-roaming horse and burro conflicts in each range was based on a subjective consideration of several factors. First, the number of horses and burros in each range was determined. Population estimates were based on actual counts since 1973. In addition, assuming they are capable of covering the same terrain that is used by bighorn, the amount of crucial bighorn habitat and total bighorn habitat used by horses and burros was considered (Map Four).

TABLE I

Analysis of Livestock - Bighorn Conflicts in Current Bighorn Habitats

Range	Crucial Bighorn Habitat: No. SH[1]	SH Density[2]	Total Area[3]	% of All Habitat	LV USE AREA[4]	%	Water Source[5]	LV Conc[6]	Livestock Use: Number of LV	Months	Use[8]	Proposed Livestock Use: % Chg. AUM's '90	% Chg. AUM's '90[9]	LS AUM's 1990	Dates	Conflict Rating[10]
Monte Cristo	70	6.3	10.8	18	4.5	42	1/1	X	1100-1200 200-700	12-5 6	S					S
Lone Mountain	144	5.3	27.0	93	8.6	31	5/10	X	1100-1225 225-700 25 125	12-5 6 7-10 11	TL					M
Silver Peak	133	1.7	68.1	53	47.3	69	7/11	X	8-1555 200-250 480-910 700-730	1-12 3-4 5-10 11-7	TL					S
Stonewall	9	2.8	2.9	63	0.1	Trace	2/1		0	0	NU					0
Spring	162	3.4	47.8	41	0.0	0	0/8		0	0	NU					0
So. Spring-Bird Sp.	70	4.3	16.2	13	9.0	56	2/3		35-	1-12	TL					L
McCullough	158	5.3	29.6	18	22.8	77	3/3	X	125-700 100	1-12 11-6[a]	TL					S
Highland	56	2.9	19.6	60	15.0	77	2/4	X	25-300 1200+ common	1-12	TL					S
W.T.-Castle	25	0.7	19.5	67	11.3	58	4/5	X	450-500	1-12[b]	TL					S
Eldorado	210	5.3[c]	19.9[c]	26	15.7	78	3/3	X	50-250	1-12	TL					S
River	210	30[d]	3[d]	0	0	0	0/4		0	0	NU					0
Gold Butte	108	7.2	1.7	85	0	0	0/1		20-50 1200-1750[e]	1-12 2-5	TL					L
Virgin Mtns.	114	3.8	2.9	50	.6	21	1/1		50-110	1-12	TL					M
Muddy	122	f	5.96	6	1.9	68	2/1		150 50-95 100-170	1-5 6-9 10-2	TL					L
Arrow Canyon	104	h	0	0	0	0	0		115-200 0 85-125	1-5 6-10 11-2	S					L
Mormon	385	12.0	32.2	65	11.1	34	2/4	X	30-5	1-5	S	+101	+376	1,550	10/15-3/30	S
Meadow Valley	155	22.1	7.0	6	0.3	61	1/1	X	160-305 200-880	5-9 10-	TL	-8	-13	10,042	10/1-3/30	S
Delamar	30	h						X	0-700	variable		-13	-9	5,779	1/1-12/31	L
Panaca	1	h							470	1-12	TL	-14	-8	5,319	1/1-12/31	L

1 = SH = Bighorn.
2 = Number/square mile of crucial habitat.
3 = Square miles of crucial habitat.
4 = LV = Livestock, areas with less than 30% slope in crucial habitat.
5 = Permanent Bighorn waters with conflicting livestock use /known permanent waters used by bighorn in the dry season.
6 = Livestock dry season concentration areas exists in sheep habitat (See Map Three).
7 = Summary of seasonal livestock numbers in sheep habitat since 1975; numbers refer to cattle unless S(sheep) or H(horses) is listed.
8 = Generalization of livestock season of use since 1975; TL = yearlong, S = seasonal; NU = no use.
9 = Proposed change in A.U.M.'s by 1990 pending range improvements.
10= S = serious, M = moderate, L = low, 0 = non-existant.

a = NW corner only.
b = Every third year.
c = Area does not include crucial habitat on National Park Service (NPS) Lands; but density value is based on all crucial habitat in the range.
d = No crucial habitat on BLM land, density applies to crucial habitat on NPS lands.
e = 21 sheep transplanted in 1979 to Virgin Mountains, animals still transitory.
f = Unknown, many sheep move to Black Mountains for summer.
g = Includes NPS Lands.
h = No crucial habitat identified.
i = Number unknown.

TABLE 3

ANALYSIS OF POSSIBLE LIVESTOCK - BIGHORN CONFLICTS IN HISTORICAL AND POTENTIAL BIGHORN HABITAT

	Potential Crucial Habitat[1]				Livestock Use			Proposed Livestock Use				
Range	Square Miles	% of All Habitat	No. of Waters	LV[2,3] Conc.	Numbers of LV	Month	Use[5]	% Change AUMs 1980	% Change[6] AUMs 1990	LV AUMs 1990	Months	Conflict[7] Rating
Historical												
Bighorn Crists	34.3	57	7		1,100 - 1,200 200 - 700 0 109	12-9 6 7-10 11	S					S
Lone Mtn.	21.0	47	3	I	1,180 - 1,305[a] 280 - 945 80 - 165 180 - 265	12-5 6 7-10 11	YL					S
Silver Peak	71.3	47	20	I	250+ [b]	Algnsec 5-10	YL					S
Palmetto-Magruder	118.7	80	35	I	1,045	1-12	YL					S
Montezuma	38.6	65	4		314	1-12	YL					S
Goldfield	14.1	51	4		0	0	NU					0
Stonewall	20.9	94	2		0	0	NU					0
Amargosa	7.7	16	1		1,369	1-12	YL					L
Sawtooth	20.9	86	4	I	320	1-12	YL					S
Johnnie	0	0	0		154	1-12	YL					L
Spring	166.7	39	44	I	154- 334 75 - 300	1-12 4-11	YL					M
So.-Bird Spring	10.5	17	7		0	0	NU					0
Sheep-Dogtn	9.7	20	1		300 - 400	1-12	YL					S
McCullough	0	0	0	I	80 - 100	11-5	S					M
N.Y.-Castle	3.6	99	1	I	450 - 900[c]	1-12	YL					S
Newberry	13.8	34	4	I	20 - 480 1,000's [d]	1-12 3-5	YL					S
Eldorado	0	0	2		75 - 250[e]	1-12	YL					L
Sunrise	0	0	0		0	0	NU					0
Gold Butte	125.0	76	24	I	500 - 750 200 - 500	3-5 6-2	YL					S
Virgin Mtns.	31.3	52	12		40 - 125 1,200 - 1,750[b]	1-12 2-5	YL					M
E. Muddy	0	0	0		250 50 - 95 165 - 295	3-5 6-9 10-2	YL					M
Dry Lake	0	0	0		20 - 100 0 40 - 50	3-5 6-10 11-2	S					L
Mormon	6.3	46	1	I	200 - 300 0	9-5 6-8	S	-43	-57	1,398	10/1-3/30	M
Meadow Valley	4.3	28	1		135 - 240 150	10-1 4-9	YL	-37	-15	2,035	10/1-3/30	M
Delamar	241.9	71	50	I	35 - 1,550	Variable	YL	+117	+175	30,960	1-12	M
Pahroc	65.3	70	14	I	800 - 1,000 100 850 - 1,400	3-5 6-10 11-2	YL	-23	-17	8,154	6/1-3/30	S
Rice	7.9	22	2	I	20 - 110 100 - 165	3-5 6-9 10-2	S	-6	+31	1,452	10/1-3/30	L
Pahranagat	0	0	0	I	175 - 360 0 80 - 330	3-6 7-10 11-2	S	-31	+12	8,356	6/1-3/30[f] 10/1-3/30[g]	M
Groom	71.1	81	17	I	470	1-12	YL	-14	-8	5,319	6/1-3/30	S
Potential												
Gold Mtn.	24.0	14	4	I	1,045	1-12	YL					S
Kern	12.4	29	1		120 - 430[h]	1-12	YL					S
Specter	0	0	0		0	0	NU					0
Clover	74.3	61	12	I	5 - 10 260 70	4 5-10 11-3	YL	-43	-73	497	6/1-10/30	L
Tempiute	0	0	0		2,300 - 2,700[i]	12-3	S	-47	-60	14,445	6/1-3/30	M
Belted	0	0	0		0	0	NU					0

[1] Areas within two miles of waters not classified as seasonal or dry in Bighorn Habitat.
[2] LV = Livestock
[3] I = Livestock dry season concentration areas exist in sheep habitat.
[4] Summary of seasonal livestock numbers in sheep habitat since 1975; numbers refer to cattle unless S (sheep) or H (horses) is listed.
[5] Generalization of livestock season-of-use since 1975; YL = yearlong, S = seasonal, NU = no use.
[6] Proposed change in AUMs by 1990 pending range improvements.
[7] S = serious; M = moderate; L = low; 0 = non-existent.

[a] 80-165 YL except in NW corner
[b] 100-750 cattle
[c] Every third year
[d] Domestic sheep adjacent to sheep range.
[e] South half
[f] North half
[g] Little use in this area

The numbers of horses and the degree that horses and bighorn habitats overlap indicate competition is not serious at this time in 15 current bighorn habitats, bu serious conflicts may exist in the Silver Peak, Stonewall, Muddy , and Meadow Valle ranges (Table 4). Serious conflicts could develop in seven historical and one potential bighorn habitat if sheep were introduced (Table 5).

Unfortunately, horse numbers are increasing in the district. For example, the Caliente Planning Unit horse population rose from 704 to 1,052 in four years. As horse numbers continue to increase, competition for forage and water will increase (McQuivey, 1978).

Proposed action for the Caliente Planning Unit would reduce wild horse numbers by 5 percent to 4,997 animals (U.S.D.I., 1979). Herd management areas would be established that would overlap with potential bighorn habitat in the north end of the Pahroc, Clover, and Delamar ranges. The management plan would eliminate curren conflicts with bighorn in the Meadow Valley and Mormon ranges.

Burro and bighorn diets are very similar; and, as a result, burros are a relatively greater threat than horses to bighorn. Although, burros often stay in less rugged areas that are marginally adequate for bighorn, serious conflicts may exist in the Eldorado and Muddy ranges (Table 4). Serious conflicts may develop in the Goldfield, Sawtooth, and Gold Butte ranges if bighorn were introduced. Potential conflicts are considered serious in the Gold Butte Range because habitat overlap is believed to be much greater than inventories have indicated. Drought conditions or increased burro populations could increase range overlap and competition for food and water throughout the district.

Industrial Activities

Since the 1800's, mining has been a part of southern Nevada's history. Miners set up claims and living quarters near water using the water for their mining activitie and personal needs (Welles and Welles, 1961). Bighorn discontinued or decreased us of these waters. Also, miners often poached sheep contributing to the decline of bighorn populations (McQuivey, 1976b and e).

Today, mining activities have decreased in intensity in the district. Mineral deposits are present, but development is not economically feasible in many cases (U.S.D.I., 1973a, 1975a, 1978). However, some mining activity is occurring in bighorn habitat. For example, companies are mining or exploring for copper in the Monte Cristo Range, lithium in the Silver Peak Range, silver in the Magruder Mountain area, gypsum in the Sunrise Mountains, and bentonite in the Muddy Range. Sand and gravel operations border present or historical bighorn habitat in the McCullough, Arrow Canyon, North Muddy, and Sunrise ranges. In addition, many small individual claims are sporadically active.

Mining operations in or adjacent to bighorn habitat can be detrimental to the sheep populations. The mining activities may force the sheep to avoid areas which may be valuable to them as escape cover or as sources of food or water. Road development that accompanies mining can increase the chances of off-road vehicle activity and can increase sight-seeing and hiking activities in the area, too, thereby adding to the potential for bighorn disturbance. The amount of habitat impacted by mining activities and the intensity of mining activities also influence the degree to whic sheep are affected.

TABLE 4

Analysis of Horse and Burro -
Bighorn Conflicts in Current Bighorn Habitat

	Horses					Burros					
		Crucial Habitat		All Habitat			Crucial Habitat		All Habitat		
Range	No.[1]	Square Miles	%	Square Miles	%	No.[2]	Square Miles	%	Square Miles	%	Conflict[3] Rating
Monte Cristo	131	0	0	19.7	33						M
Lone Mtn.	88	2.7	10	5.8	20						M
Silver Peak	399	41.6	61	71.1	57						S
Stonewall	83	2.9	100	4.6	100						S
Spring	6	2.0	4	5.3	5	75	2.8	6	22.7	19	L
So.Bird Spring	48	1.2	7	32.1	29	44	1.2	7	32.1	29	M
McCullough	32	0	0	6.9	4	67	0	0	6.9	4	L
Highland											0
N.Y.-Castle											0
Eldorado						190[a]	5.5	28	15.5	21	S
River											L[a]
Gold Butte											0
Virgin	35	0	0	1.9	33						L
Muddy	15	2.0	34	19.6	21	59	2.0	34	19.6	21	S
Arrow Canyon						70	0	0	16.5	23	L
Mormon	92	5.1	16	16.0	13						M
Meadow Valley	57	7.0	100	45.7	42	70	0	0	2.0	2	S
Delamar											0
Pahranagat											0

1 - Horse population estimate based on inventories since 1973; actual count ÷ .75 = estimated numbers in 1975, assume increase of 10% each year since 1975.
2 - Burro population estimate based on inventories since 1973; actual count ÷ .46 = estimated numbers in 1975, assume increase of 10% each year since 1975.
3 - S = Serious, M = Moderate, L = Low, C = Non-existant
a - Burros present on National Park Service lands.

TABLE 5

Analysis of Possible Horse and Burro - Bighorn Conflicts in Historical and Potential Bighorn Habitats

	Horses					Burros					
		Crucial Habitat		All Habitat			Crucial Habitat		All Habitat		
Range	No.[1]	Square Miles	%	Square Miles	%	No.[2]	Square Miles	%	Square Miles	%	Conflict[3] Rating
Historical											
Monte Cristo	131	34.3	100	60.4	100						S
Lone Mtn.	88	21.0	100	44.8	100						S
Silver Peak	399	47.0	65	126.2	83						S
Palm.-Magruder	217	32.2	28	42.1	29						M
Montezuma	188	30.3	79	39.1	66						S
Goldfield	24	14.1	100	23.1	83	91	14.1	100	23.1	83	S
Stonewall	83	20.9	100	32.2	100						S
Amargosa											0
Sawtooth	220	6.8	33	8.9	37	234	6.8	33	8.9	37	S
Johnnie	143	0	0	24.2	49	63	0	0	24.2	49	M
Spring	67	29.0	25	111.9	26	56	29.0	25	111.9	26	L
So.-Bird Spring	48	1.7	100	1.7	3	44	1.7	100	1.7	3	M
Sheep Roach											0
McCullough											0
N.Y.-Castle											0
Newberry											0
Eldorado											0
Sunrise											0
Gold Butte						354	3.0	2	9.1	6	S
Virgin Mtns.	35	0	0	3.2	3						L
N. Muddy											0
Dry Lake											0
Mormon	10	2.0	32	2.0	14						L
Meadow Valley											0
Delamar	294	176.5	73	195.6	58						M
Pahroc	52	35.0	54	42.6	46						M
Hiko											0
Pahranagat											0
Groom											0
Potential											
Gold Mtn..	40	12.0	50	49.2	29						M
Bare	220	1.0	8	7.4	18	234	1.0	8	7.4	18	M
Specter											0
Clover	156	49.9	67	77.4	64						S
Tempiute											0
Belted	48	0	0	17.5	21						M

1 - Horse population estimate based in inventories since 1973; actual count÷.75 = estimated numbers, assume increase of 10% each year.
2 - Burro population estimate based on inventories since 1973; actual count÷.46 = estimated numbers, assume increase of 10% each year.
3 - S = Serious, M = Moderate, L = Low, 0 = non-existant.

All these factors were considered subjectively when rating the impact of mining. Only the Palmetto-Magruder Range seems to support enough mining activity capable of seriously affecting sheep locally if they were introduced (Table 6). This activity occurs along the Nevada-California stateline.

As economic factors change, mining activity may become prevalent in new areas (U.S.D.I., 1973a). Nearly every range has potential. Oil and gas leases cover every range lying above the overthrust belt in the district. This area includes most of the Virgin Valley and Stateline planning units. Mineral deposits are especially prominent in the northwest third of the district (U.S.D.I., 1975a). Future mining developments are possible there.

Powerline corridors and communication sites can be detrimental to bighorn, too. Powerline and communication sites usually require service roads. These roads are often used by recreationists whose activities can lead to harassment of bighorn sheep if the roads enter their habitat. This was the primary fact considered in analyzing impacts of powerlines and communication sites. These uses create serious local problems in current bighorn habitat of the McCullough Range (Table 6).

The cumulative effect of all industrial activities was considered in deriving an overall industrial impact rating. Industrial land uses do not seem to create extensive, serious problems for bighorn except in the South Spring-Bird Spring habitat.

Recreational Impacts

Recreational impacts before 1900 were probably minimal, but recent impacts have grown with increases in population and leisure time. Off-road vehicles (ORV's) are used throughout the district. Unorganized, non-competitive ORV activity can occur in any of the mountain ranges. Trails are common in the Tempiute, Groom, Pahranagat, Delamar, and Mormon ranges (U.S.D.I., 1978).

Weekend ORV activity including camping in remote areas can lead to harassment and poaching of sheep, can keep bighorn away from waters, and can cause a loss of forage due to habitat destruction. Competitive ORV events occur within or adjacent to several current and historical ranges.

Few picnicking and/or camping areas are developed except near highways and in the Las Vegas vicinity (U.S.D.I., 1973b, 1975a, 1978). Such developments are usually located adjacent to water sources. They exclude bighorn use of some waters in the Spring, South Spring-Bird Spring, and Muddy ranges. Such developments exist at historical bighorn waters in the Gold Butte, Virgin, and Pahroc ranges.

Two areas within the district have been developed as large scale recreation areas. The Red Rocks Canyon Recreation Lands encompasses all but the northern end of current bighorn range in the Spring Mountains. Several important bighorn waters can be approached by vehicle. Picnicking occurs at several other waters that are accessible by hikers. In the future, a horse trail and primitive camp sites may be constructed adjacent to excellent escape cover for sheep.

The Valley of Fire State Park is located in the southern end of the North Muddy Range. Facilities developed at springs in this area may have ended sheep use of these waters resulting in the loss of the North Muddy habitat for bighorn.

TABLE 6

Analysis of Conflicting Industrial and Recreational Land Uses in Current, Historical, and Potential Bighorn Habitat

	Industrial Sites				Recreational Sites		
	Mines	Power-lines	Comm. sites	Overall Conflict Rating	Comp. O.R.V.	Other Recr.	Overall Conflict Rating
Current							
Monte Cristo	L[1]	0	0	L	0	0	0
Spring	L	0	0	L	0	S	S
So.-Bird Spring	M	M	M	S	M	S	S
McCullough	0	S	M	M	M	0	M
Highland	0	M	0	M	0	L	L
N.Y.-Castle	L	0	0	L	M	0	M
Eldorado	M	M	M	S	M	0	M
River	0	L	L	L	0	L	L
Virgin Mtns.	0	0	0	0	0	L	L
Muddy	L	0	0	L	M	S	S
Arrow Canyon	L	0	0	L	0	0	0
Mormon	0	0	0	0	0	L	L
Historical							
Monte Cristo	L	0	0	L	0	0	0
Silver Peak	L	L	0	L	0	0	0
Palmetto-Magruder	S	L	0	M	0	0	0
Montezuma	0	M	M	M	0	0	0
Goldfield	L	0	0	L	0	0	0
Sawtooth	M	M	M	M	0	0	0
Spring	L	0	L	L	0	L	L
So.-Bird Spring	0	0	0	0	L	L	L
Sheep-Roach	0	L	0	L	L	0	L
McCullough	L	0	0	L	L	0	L
N.Y.-Castle	L	0	0	L	L	0	L
Newberry	0	0	0	0	M	0	M
Eldorado	0	M	0	M	M	0	M
Sunrise	M	M	0	M	0	M	M
Gold Butte	0	0	0	0	0	M	M
Virgin Mtns.	0	0	0	0	0	M	M
N. Muddy	L	0	0	L	L	S	S
Dry Lake	L	L	0	L	L	0	L
Mormon	0	0	M	M	0	0	0
Delamar	0	L	L	L	L	M	M
Pahroc	0	0	0	0	0	M	M
Hiko	0	0	L	L	0	0	0
Pahranagat	L	L	L	L	0	L	L
Groom	0	0	0	0	0	L	L
Potential							
Gold Mtn.	0	M	M	M	0	0	0
Bare	L	L	L	L	0	L	L
Clover	0	L	L	L	0	M	M
Tempiute	L	L	0	L	0	L	L

1 - S=Serious, M = Moderate, L = Low, 0 = non-existant

Impacts of recreational land uses on bighorn sheep has been determined through subjective analysis. The frequency, intensity, and location of recreational activities were considered in each case. Serious conflicts may exist in current habitat of the Spring, South Spring-Bird Springs, and Muddy ranges and in historical habitat of the North Muddy Range (Table 6).

Demands for unorganized and competitive ORV experiences will probably increase in the future, increasing the potential for bighorn harassment. Demand for developed recreational facilities will increase, too. Increased recreational activity in bighorn habitat will not benefit the sheep.

Habitat Deficiencies

Vegetation

Very little work has been done in the area of quantifying habitat deficiencies. Lower limits of vegetative cover and forage availability bighorn can tolerate are unknown. While perennial grasses appear to be the preferred food source (McQuivey, 1978), sheep are very adaptable.

Percent grass cover varies with elevation and aspect and is variable within each mountain range. Based on data from the southern part of the Las Vegas District, sheep seem to do well on ranges with grass cover below 0.3 percent. They may avoid foraging in areas with excellent grass cover (up to 2.0 percent) favoring areas with less grass cover but better escape cover (Bradley, 1972). This illustrates the need for an adequate food source close to escape cover.

The ability of bighorn to sustain themselves in areas with little grass cover is also supported by data from the River Mountains. The creosote bush community covers this range; grass cover is minimal. But, the sheep density is the highest in the state (McQuivey, 1978). Therefore, while lower limits of tolerable vegetative cover are unknown, it appears that bighorn would be able to survive even on the most sparsely covered ranges in the district if competition from other species for forage and water was not detrimental.

Bighorn prefer open terrain that provides good viewing rather than densely covered terrain (Bradley, 1971). Areas with dense pinyon-juniper growth are not used extensively. Pinyon-juniper communities of various densities cover 1,715 square miles of bighorn habitat in the district. It dominates in the Groom, Tempiute, North Delamar, and Spring ranges and may have an adverse impact on bighorn reintroductions to these ranges. On these and all other ranges, however, there are opportunities to open up the terrain and increase grass cover through pinyon-juniper management. Pinyon-juniper cover is summarized in Table 7.

Escape Cover

It was assumed that escape cover is adequate in all current bighorn ranges. Analysis of topographic maps indicates escape cover is marginally adequate in the potential habitat of the Tempiute Range and in the historical portions of the following nine ranges: Lone Mountain, Spring, South-Bird Spring, McCullough, New York-Castle, Eldorado, Goldfield, North Muddy, and Dry Lake. These ranges were identified after considering the overall ruggedness of the terrain and the amount and distribution of adequate escape terrain throughout the possible habitat.

TABLE 7

Square Miles of Pinyon-Juniper Cover in Bighorn Habitat

Range	Current Habitat	Historical Habitat	Potential Habitat
Silver Peak	22.9 (18)[a]	33.0 (22)	
Spring	18.4 (16)	194.7 (35)	
So. Spring-Bird Sp.	28.0 (26)		
McCullough	26.0 (16)		
N.Y.-Castle	1.7 (06)		
Virgin Mtns.		26.5 (25)	
Meadow Valley	26.8 (25)		
Delamar	4.4 (11)	171.7 (51)	
Pahranagat		3.9 (03)	
Palmetto-Magruder		54.8 (38)	
Montezuma		6.0 (10)	
Newberry		4.1 (10)	
Gold Butte		6.6 (04)	
Pahroc		29.4 (32)	
Groom		53.1 (60)	
Gold Mtn.			4.2 (02)
Clover			80.2 (66)
Tempiute			23.3 (100)

[a] Percent of bighorn habitat in parenthesis

All but the Tempiute Range received some documented bighorn sheep use historically; however, the use was probably intermittent as sheep migrated between areas with better escape cover. These migrations are much less common now due to road and fence development in the valleys between bighorn ranges (McQuivey, 1978). Good escape cover is available in the remaining 25 historical and potential bighorn habitats and in all current bighorn habitats.

Water

Areas with adequate food and escape cover are of no value to sheep if water is not available for at least part of the year. The present distribution of water is inadequate to allow optimum use of the habitat in all current bighorn areas except Lone Mountain. All other current bighorn areas could use water development projects to increase the amount of yearlong range or to increase the amount of time sheep could utilize drier portions of their habitat. All of the historical bighorn areas lack adequate water to enable optimum utilization of the total habitat available.

It is very difficult to obtain accurate and complete information on water sources within the district. No single reference within the district provides complete data; many sources are outdated. To insure effective use of funds more effort will be needed prior to water development in bighorn areas to verify the accuracy of information on number of waters, location of waters, amount and seasons of flow, possession of water rights, and potentials for developing storage facilities. Reintroductions into ranges that appear poorly watered should not be ruled out before a more thorough study is made of water availability.

PROPOSED MEANS OF INCREASING POPULATION LEVELS

Reintroductions

Increasing sheep numbers and distribution in historical and potential habitat in the district will usually require reintroduction projects. Enclosures at release sites will not be used. Potentials for predation and for physical stress through forage depletion as well as excessive costs of such operations exceed the uncertain benefits of enclosures. Efforts will be made to release sheep in areas providing adequate forage, escape terrain, and water. This should reduce the stress on the sheep reestablishing in new areas and eliminate the need for the sheep to move elsewhere to find appropriate habitat.

Post-release bighorn monitoring programs will be included with future reintroductions. Such programs will provide insight into the needs of sheep on each range and into the potential for habitat enhancement.

Habitat Improvements

Improving seasonal springs and developing natural or man-made water catchments which prolong use of seasonal range reduces grazing pressure on crucial bighorn habitat. These projects coupled with vegetative manipulations when needed all increase the amount of forage available to bighorn.

Water developments will benefit bighorn throughout the district. Information available on waters in each range should be verified and improved during HMP

development. Control of water rights should be determined for all waters that may be beneficial to bighorn. These water rights should be obtained when possible.

Water developments will include increasing flows at existing springs with the use of the horizontal drill owned by the Nevada Department of Wildlife. Seep flows may be improved by excavating sources, lining the bedrock, and piping the collected water to storage tanks and troughs. Small scale improvements of this nature may be relatively cheap, costing less than $5,000 each, and can help to distribute sheep seasonally. Table 8 indicates how much crucial habitat expansion is possible in current habitat through development of all yearlong, seasonal, and dry springs and in historical and potential habitat through development of seasonal and dry springs. The expansion in historical and potential habitats is an increase beyond the crucial area that is assumed to exist as discussed in the livestock conflict section. The location of known water sources used by bighorn and all other permanent, seasonal, and dry sources in bighorn habitat are shown on Map Five.

Unfortunately, the uncertainty of water rights in Nevada, the complications involved in sharing improved water sources, and the shortage of permanent waters available in bighorn habitat may hamper plans for development of existing sources. Therefore, a need for rain water catchment projects is anticipated in most ranges.

Small scale catchments including an apron, storage tank with a storage capacity of no more than 5,000 gallons, and a big game watering trough may cost $7,500 dollars for materials and installation. These facilities can help to distribute sheep seasonally, and in wet years they may provide water yearlong if properly placed in sheep habitat.

Large scale projects with storage facilities capable of supporting sheep populations throughout the year including drought years will be necessary in order to realize the opportunities for expanding bighorn populations and habitat in areas lacking permanent water. Koplin (1960) observed wild rams drinking 2.5 gallons during each trip to water. Welles and Welles (1961) found sheep water every 3-5 days in the hot, dry season and every 10-14 days in the cool season. Assuming this data is fairly accurate, 350 gallons of water per sheep annually should far exceed the need.

Development of large projects will include construction of dams in steep draws or of large catchment aprons in less steep terrain. Water can be stored in tanks with capacities as large as 80,000 gallons. A water project with this much storage capacity could support 76 sheep yearlong even if the tank was filled only once every third year. Such a project could be completed for $20-25,000. If properly designed and placed, these projects will require little maintenance and economically enhance bighorn populations.

Vegetative manipulation will involve removal of pinyon-juniper cover where feasible. Plant succession following treatment should include an increase in grass cover. Potentials for these projects exist in seven current, 11 historical, and three potential bighorn areas (Table 7). Costs for removal of pinyon-juniper cover by burning average $3.50/acre on the Kaibab National Forest (Lynn Thomas, pers. comm.). Costs may be a little higher in this district.

TABLE 9

ANALYSIS OF BIGHORN POPULATION AND HABITAT CHARACTERISTICS, CONFLICTING LAND USES, AND BLM AND NDW PLANNING SYSTEMS IN EACH BIGHORN HABITAT

	Bighorn Population and Habitat Characteristics					Conflicting Land Uses				Habitat Characteristics			Planning			Priority for Development		
Range	BH[1] No.	BH Density	Crucial[2] Area	% Crucial Area	Total[2] Area	Livestock	Horse Burro	Industry	Recreation	% Pinyon Juniper	Escape Cover	Possible[3] Add. Crucl. Habitat	MFLP	AMLP[4]	NDW[5]	1st	2d	3d
Current																		
Monte Cristo	70	6.5	10.8	18	59.4	S[6]	M	L	O		good	30.4	P[b]	C[a]	1	X-T[d]		
Lone Mtn.	146	5.3	27.4	95	28.7	M	M	O	O		good		P	C			X	
Silver Peak	112	1.7	66.1	55	124.4	S	S	O	O	22.9	good	13.5	C	P		X-T		
Stonewall	4	2.8	2.9	83	4.6	O	S	O	O		good		P				X	
Spring	102	3.4	47.8	41	116.9	O	L	L	S	18.4	good	30.0	C			X		
So.-Bird Spring	70	4.3	16.2	15	109.4	L	M	S	S	28.0	good	26.7				X		
McCullough	158	5.3	29.6	18	164.4	S	L	M	M	26.0	good	32.2	P	P		X		
Highland	54	2.9	19.8	50	32.6	S	O	M	L		good	10.3	C	P			X	
B.T.-Castle	25	0.7	19.5	67	29.0	S	O	L	M	1.7	good		P					X
Eldorado	410	6.3[e]	19.8	26	75.4	M	S	S	M		good	21.5	P	P		X		
River	210	30.0[f]	0	0	19.5	O	L	L	L		good							X
Gold Butte	10	7.2	1.7	85	2.0	L	O	O	O		good		P	P	3	X		
Virgin Mtns.	11	3.8[f]	2.9	50	5.8	M	L	O	L		good	3.0	P	P		X		
Muddy	122	—	5.3[g]	6	93.5	L	S	L	S		good		P			X		
Arrow Canyon	104	—	0	0	71.2	L	L	L	O		good		P			X		
Mormon	385	12.0	32.2	26	123.1	S	M	O	L		good	15.9	P	P		X		
Meadow Valley	155	22.1	7.0	6	108.2	S	S	O	O	26.8	good	6.8	P	P		X		
Delamar	50	—	— [h]	—	41.1	L	O	O	O	4.4	good	11.3	P	P	4	X		
Pahranagat	—[i]	—	— [h]	—	19.4	L	O	O	O		good			P			X		
Historical																		
Monte Cristo			34.3	57	60.4	S	S	L	O		good		P		1	X-T[d]		
Lone Mtn.			21.0	47	44.8	S	S	O	O		poor							X
Silver Peak			72.3	47	152.5	S	S	L	O	33.0	good			C		X-T		
Palmetto-Magruder			116.7	80	145.2	S	M	M	O	54.8	good		P	C			X-T	
Montezuma			38.4	65	59.1	S	S	M	O	9.0	good		P				X-T	
Goldfield			14.1	51	27.9	O	S	L	O		poor							X-T
Stonewall			20.9	94	22.2	O	S	O	O		good		P				X	
Amargosa			7.7	19	40.9	L	O	O	O		good		P	C		X-T		
Sawtooth			20.9	86	24.2	S	S	M	O		good							X-T
Johnnie			0	0	49.3	L	M	O	O		good							X-T
Spring			116.7	39	425.6	M	L	L	L	194.7	poor	23.2	P	P				X-T
So.-Bird Spring			10.5	17	63.2	O	M	O	L		poor			P			X	
Sheep-Roach			6.7	20	34.0	S	O	L	L		good			P				X-T
McCullough			0	0	14.3	M	O	L	L		poor		P	P				X
B.T.-Castle			3.6	69	5.2	S	O	L	L		poor		P					X
Hayberry			13.8	34	41.1	S	O	O	M	4.1	good	6.2	P	P		X-T		
Eldorado			0	0	13.4	L	O	M	M		poor		P	P				X
Sunrise			0	0	30.3	O	O	M	M		good							X
Gold Butte			125.0	76	164.1	M	S	O	M	9.6	good	10.9	P	P	3	X-T		
Virgin Mtns.			51.3	52	98.3	S	L	O	M	26.5	good	1.4	P	P		X-T		
E. Muddy			0	0	58.3	M	O	L	S		poor							X-T
Dry Lake			0	0	37.0	L	O	L	L		poor							X-T
Mormon			6.3	46	13.8	M	L	M	O		good		P	P				X
Meadow Valley			4.3	25	16.2	M	O	O	O		good		P	P				X
Delamar			241.9	71	339.4	M	M	L	M	171.7	good			P	4	X		
Pearoc			95.3	70	93.3	S	M	O	M	29.4	good		P	P	5	X-T		
Kiko			7.9	22	35.6	L	O	L	O		good			P			X-T	
Pahranagat			0	0	120.5	M	O	L	L	3.9	good			P		X		
Groom			71.1	81	87.8	S	O	O	L	53.1	good		P	P	2	X-T		
Potential																		
Gold Mtn.			24.0	14	169.2	S	M	M	O	6.2	good		P	C				X-T
Bare			12.1	29	41.1	S	M	L	L		good		P				X-T	
Spector			0	0	44.1	O	O	O	O		good							X-T
Clover			74.3	61	121.2	L	S	L	M	40.2	good			P				X-T
Tempiute			0	0	23.3	M	O	L	L	23.3	poor			P				X-T
Delamar			0	0	84.8	O	M	O	O		good						X-T	

1 BH = Bighorn
2 Square miles
3 Possible additional crucial habitat with development
4 Allotment management plan or grazing system
5 Previous Nevada Department of Wildlife priorities for bighorn reintroductions

a Conflict ratings: S = serious, M = moderate, L = low, O = non-existent
b P = proposed in Management Framework Plan
c C = completed
d T = indicates a bighorn reintroduction is planned
e Density value based on all crucial habitat, including NFS lands
f No crucial habitat on BLM lands, density applies to crucial habitat on NFS lands
g Includes NFS lands
h No crucial habitat identified
i Numbers unknown

Competition Reduction

Competition for food and water can be reduced, too. Livestock conflicts in sheep habitat can be resolved by various methods. Springs used by livestock can be fenced off through cooperative agreements in a manner allowing bighorn access but preventing livestock access; then, some water can be piped to livestock in areas where bighorn-livestock conflicts are not likely to occur.

Livestock operators can be requested to enter into cooperative agreements to leave float valves in operation even when livestock are moved from the water source to insure water is available to bighorn yearlong. In other cases, projects can be authorized to pipe some water from corralled sources to areas accessible to bighorn outside the corrals.

New range surveys in the Caliente, Virgin Valley, and Stateline planning units will allow adjustments in livestock grazing allocations, too. Hopefully, this action coupled with increased efforts at eliminating livestock trespass will reduce livestock conflicts.

Competition with horses and burros can be reduced by fencing water sources when local terrain will still allow bighorn access. Fencing costs average about $2,000 per mile. Horse and burro management plans which allow removal of horses and burros from certain areas will be encouraged wherever conflicts exist, especially in the Silver Peak and Gold Butte ranges. At present, average horse removal costs are $300 per animal.

Public use restrictions can reduce sheep harassment and enable sheep to make full use of the suitable habitat. Efforts will be made to eliminate or restrict ORV activity, camping, and picnicking at least seasonally when such activities prevent sheep from using a critical portion of their habitat. Industrial activities requiring road construction should be regulated to reduce immediate and long term impacts on bighorn habitat.

COOPERATIVE ACTION PLAN

Present Status of Planning

The present status of planning within BLM's Las Vegas District and NDW's Region III must be considered when developing a coordinated plan for expanding bighorn numbers and improving bighorn habitat. An effort should be made to comply with past management decisions when possible to insure that proposed actions can be implemented without avoidable complications.

BLM Planning System

The management decisions within the BLM are presented in Management Framework Plans (MFP's). The new MFP for the Caliente Planning Unit was written in the 1979 fiscal year (FY). Public review of the grazing environmental statement was completed by August, 1979. Management decisions will not be finalized until early in FY 1980. However, for the purpose of this report, it is assumed that the new MFP decisions will remain unchanged and will be effective during FY 1980. New MFP's for Virgin Valley and Stateline planning units will be completed in FY 1980. A new set of decisions will be developed for the Esmeralda Planning Unit in FY 1985.

Bureau of Land Management decisions that are considered important to bighorn and will be in effect in FY 1980 are listed below (U.S.D.I., 1975b and c, 1976, 1979).

1. Wildlife Habitat Management Plans should be developed in 22 current, historical, and potential bighorn areas. These areas are identified in Table 8.

2. Inventories should be conducted to determine bighorn status, bighorn habitat conditions and requirements, and opportunities for bighorn habitat development in the Caliente, Stateline, and Esmeralda planning units.

3. Minor improvements can be made for bighorn in the Delamar Range without an HMP.

4. The possibility of rehabilitating 1,800 acres for deer and bighorn habitat in the Silver Peak Range should be investigated.

5. Allotment Management Plans (AMP's) should be developed in allotments overlapping with 33 current, historical, and potential bighorn ranges. These areas are identified in Table 8.

6. Pinyon-juniper manipulation is approved in portions of current and historical bighorn habitat in the Esmeralda and Virgin Valley planning units and throughout the Caliente Planning Unit.

7. Off-road vehicle activity is prohibited off trails in crucial bighorn habitat throughout the Esmeralda and Caliente planning units and in all or portions of the Spring, McCullough, Highland, Newberry, Eldorado, Sunrise, Gold Butte, Virgin, Muddy, and Arrow Canyon ranges.

8. Crucial bighorn habitat is closed to mineral exploration in the Spring Range. It is closed to mineral leasing in the McCullough, Highland, Mormon, and Meadow Valley ranges.

9. No recreational facilities will be developed within one-quarter mile of bighorn waters in the Esmeralda Plannig Unit and in current habitat in the Spring, McCullough, and Highland ranges.

10. Horse numbers should be reduced in crucial bighorn habitat in the Silver Peak Range. Horses and nuisance burros should be removed from the Muddy and Arrow Canyon ranges, respectively. The number of horses throughout the Caliente Planning Unit should be reduced. Horse and burro management areas should be established in portions of the Spring, Meadow Valley, Delamar, Clover, and Pahroc ranges.

11. Separate burro and bighorn waters should be developed by fencing in the Muddy and Gold Butte ranges.

12. No new communication sites will be developed in the Caliente Planning Unit except for a roadless site in the Mormon Range.

13. No rights-of-way for roads will be approved in the Arrow Canyon Range.

14. No pinyon-juniper stands will be removed in 15,000 acres of the Gold Butte Range.

Three HMP's have been written for bighorn habitat in the district. Management decisions presented in these plans have not been fully implemented. Funds and manpower have been inadequate to allow maintenance or improvements. The decisions are briefly discussed below.

The Silver Peak HMP called for expanding crucial bighorn habitat by reducing livestock numbers, establishing a livestock grazing system, managing wild horses on the range, developing guzzlers and springs, and increasing grass cover by manipulating pinyon-juniper stands. Only four guzzlers have been installed due to a shortage of manpower and funds. Further implementation should include horse removal.

The Red Rock HMP includes most of the current bighorn habitat in the Spring Range. This plan proposed development of guzzlers and natural tanks for bighorn and prohibited trails and campsites within one-quarter mile of bighorn waters. It should be revised since the Red Rocks Master Plan has been changed and a new Red Rocks Recreation Plan has been developed.

The Highland HMP sought to prohibit livestock water developments in the northeast corner of the Highland Range, reduce the number of livestock concentrating at Cow Spring, and develop and maintain waters for bighorn. This plan has been a success. However, livestock still concentrate at Cow Spring and additional water developments would be beneficial.

NDW Planning System

A list of potential bighorn transplant sites approved by the BLM in 1977 has been the basis for planning by the Nevada Department of Wildlife. Development of an HMP prior to bighorn introductions has been waived for the Stonewall, Virgin, Monte Cristo, Groom, Gold Butte, Delamar, and Pahroc ranges in the Las Vegas District.

The NDW's priorities for reintroductions have followed the order of the preceding list. To date, attempts have been made to reestablish sheep on the Stonewall and Virgin Mountain ranges. The sequence for sheep reintroductions proposed in this report has been developed in conjunction with the NDW following consideration of the 1977 priority list. It is approved by the BLM and NDW.

Priorities for HMP Development and Planning

Time Framework Plan

Bighorn population levels can be increased throughout the district through reintroduction programs, habitat improvements, and competition reduction. Physical characteristics of bighorn habitat, land use conflicts, and BLM and NDW planning systems were analyzed for each range to subjectively determine the opportunities for habitat expansion and the need for habitat preservation. Each range was then ranked as a high, moderate, or low priority range for HMP development. Table 8 presents the data used in this subjective analysis.

Since many of the current, historical, and potential ranges are small and/or adjacent to other bighorn habitats, the 54 ranges were arranged into 38 possible Wildlife Habitat Areas (WHA's) for HMP development. Then the ranking of each range based on the need to preserve or the opportunity to expand bighorn habitat was used to place the WHA's into first, second, and third priority groups for HMP development (Table 9).

The time framework for preparing HMP's was developed from the priority groupings. The cooperative action plan can reach full scale operation by 1982. Final selection of three WHA's for HMP development in the following year, development of three HMP's, and partial implementation of several HMP's will be included in the Annual Work Plan each year.

The initial phase of HMP implementation in each WHA is scheduled for the first fiscal year following HMP development. Development of waters and removal of horses and burros is anticipated in this phase. Reintroduction programs are planned to follow water development and horse and burro removal by one year. However, reintroductions and other phases of implementation can be moved up to the first year of HMP implementation if fieldwork has indicated water conditions are adequate to support the sheep at the present time and if horse and burro conflicts do not require immediate action.

Table 10 presents the time framework for HMP development and implementation and Table 11 presents the time framework for sheep reintroductions. Bighorn reintroductions in the Virgin Mountains and the Gold Butte Range depend on the movements of 21 bighorn released on the south side of the Virgin Mountains in June, 1979. At this time the sheep are utilizing portions of the Virgin Mountains and portions of the Gold Butte Range. The additional releases in other locations on these ranges may be necessary to insure full use of the available habitat. Bighorn releases in the Silver Peak, Palmetto-Magruder, and Bare ranges are not advisable unless some horses and burros are removed prior to releasing sheep. In addition, a reintroduction in the Silver Peak Range should be delayed at least a few years after horse removal since the sheep may drift back to the historical range when horse competition is reduced.

Cost Estimates and Manpower Needs

Cost estimates for full implementation of first and second priority HMP's is presented in Table 12. Although cost estimates were not prepared for third priority ranges, this does not reflect a lack of interest in developing HMP's in these areas. In fact, these areas may replace other more highly rated areas following initial field trips to the proposed WHA's. However, it is assumed that the WHA's are properly rated and HMP development and implementation in third priority ranges is too far away to warrant estimating costs at this time.

Development of 23 new HMP's, revision of one HMP, and implementation of 23 new and three present HMP's will cost approximately $6,121,250 (Table 12). Itemized costs include the following:

1. Nine work-months for initial field trip to each WHA and for inventory, development of HMP, and implementation - $1,750/work-month;

TABLE 9

Priority Rating for 38 Possible Wildlife Habitat Areas
for HMP Development

First Priority	Second Priority	Third Priority
Mormon	Bare - T	Goldfield - T
Virgin Mtns. -T[a]	Palmetto-Magruder -T	Johnnie -T
Gold Butte -T	Stonewall	Specter -T
Arrow Canyon	Montezuma -T	Gold Mtn. -T
Groom -T	Lone Mtn.[b]	N. Muddy -T
Newberry	Hiko -T	Dry Lake -T
Muddy	Belted -T	Sawtooth -T
Delamar	N.Y. -Castle	Spring[c] -T
McCullough		Sheep-Roach -T
Meadow Valley		Clover -T
Pahroc -T		Tempiute -T
Amargosa -T		Sunrise -T
So.-Bird Spring		Lone Mtn.[c] -T
Monte Cristo -T		River
Eldorado		
Pahranagat		

a - T indicates bighorn reintroduction planned
b - current habitat
c - historical habitat

TABLE 10

Time Framework for Habitat Management Plans

Fiscal Year	Development	Initial Implementation
1980	Mormon Virgin Mtns. -T[a]	Mormon
1981	Gold Butte -T Arrow Canyon Groom	Virgin -T Silver Peak -T[b]
1982	McCullough Pahranagat Pahroc -T	Gold Butte -T Arrow Canyon Groom -T
1983	Eldorado Delamar South-Bird Spring	McCullough Pahranagat Pahroc -T
1984	Stonewall Monte Cristo -T Meadow Valley	Eldorado Delamar South-Bird Spring
1985	Newberry Muddy Bare -T	Stonewall Monte Cristo -T Meadow Valley
1986	Amargosa -T Lone Mountain Palmetto-Magruder	Newberry Muddy Bare -T
1987	Montezuma -T Belted -T Hiko -T	Amargosa -T Lone Mountain Palmetto-Magruder -T
1988	N.Y.-Castle Spring Mountain[c]	Montezuma -T Belted -T Hiko -T
1989		N.Y.-Castle Spring Mountain Highland[b]

a - "T" indicates a bighorn reintroduction is planned.
b - HMP already developed, ready for additional implementation, reintroduction delayed until 1985 to determine if it is needed.
c - Present HMP should be revised.

TABLE 11

Time Framework for Bighorn Reintroductions

Fiscal Year	Transplant Location
1980	---
1981	Virgin Mountains
1982	Groom
1983	Gold Butte
1984	Pahroc
1985	Silver Peak[a]
1986	Monte Cristo
1987	Bare Mountain
1988	Amargosa
	Palmetto-Magruder
1989	Montezuma
	Belted
	Hiko

a - Only if it is needed to expand current distribution into historical range

TABLE 12

Man-Months and Cost Estimates for HMP Completion

Range	HMP Development and Projects										
	Man-Months	Inventory	Fencing[1]	P-J Manip[2]	H and B Removal[3]	Spring Develop[4]	Small Catch[5]	Large Catch[6]	Trans-Plant	Pop. Increase[7]	Cost for Total Impl.[8]
Mormon	9	X	10		102		5	2		176	158,850
Virgin-T[b]	9	X	10	3200	43			6	1	415	219,650
Silver Peak[c]T	9	X	20	640	533	7		14	1	1022	609,650
Gold Butte-T	9	X	10	640	254			9	1	671	345,950
Arrow Canyon	9	X	10		70			4		292[a]	161,750
Groom-T	9	X	10	6400				5	1	360	196,750
McCullough	9	X	10	5120	47			8		576	278,850
Pahranagat	9	X	10	640				8		574[a]	243,750
Pahroc-T	9	X	10	5120	14		2	5	1	383	209,950
Eldorado	9	X	10		176			5		332	218,550
Delamar	9	X	20					10		709[a]	310,750
South-Bird Spring	9	X	10	5120	147			9		638	333,850
Stonewall	9	X	10		120			2		143	126,500
Monte Cristo-T	9	X	20		196			6	1	421	270,550
Meadow Valley	9	X	10		230			5		355	234,750
Newberry	9	X	10	640			3	2		169	116,250
Muddy	9	X	10		144		2	5		383[a]	223,950
Bare-T	9	X	10		683		3	2	1	169	319,150
Amargosa-T	9	X	10					3	1	192	116,750
Lone Mountain	9	X	10		128					0	79,150
Palmetto-Magruder-T	9	X	10	9600	456			8	1	595	423,550
Montezuma-T	9	X	10	640	419		3	3	1	242	267,950
Belted-T	9	X			113			5	1	348	180,650
Hiko-T	9	X	10					2	1	146	91,750
N.Y.-Castle	9	X	10					2		115	90,750
Spring Mountain[c]	2	X	10	5120	210	4	2	3		317	225,500
Highland[d]	2	X	10					1		78	65,750
Total	229		280	42,880	4,085	11	20	134	12	9,821	6,121,250

1 - Number of miles.
2 - Acres of Pinyon-Juniper burning, allow $3,000/640 acres.
3 - Horse and Burro removal, number of animals is listed.
4 - Number of springs to be developed.
5 - Number of 5,000 gallon catchments to be developed.
6 - Number of 80,000 gallon catchments to be developed.
7 - Population increase following implementation.
8 - Total cost of implementation.

a - Population is migratory, population increase following HMP implementation indicates a new yearlong population.
b - "T" indicates a bighorn reintroduction is planned.
c - HMP should be revised prior to implementation.
d - HMP developed, ready for further implementation.

2. Inventory for HMP development, primarily helicopter time - $5,000/inventory;

3. Pinyon-juniper manipulation - $3,000/640 acres;

4. Horse and burro removal, assuming cost is the same for both animals - $300/animal;

5. Spring development - $5,000/spring;

6. Small catchment construction - $7,500/catchment;

7. Large catchment construction - $25,000/catchment;

8. Work-months for reintroduction - $1,000/reintroduction.

Maintenance expenses are not included in the development and implementation cost estimates. These costs are estimated to run about $5,000 each year beginning in FY 1984.

Due to the large amount of money required for full implementation of each HMP, partial implementation of several HMP's is planned for each fiscal year. Fixed annual expenses include $47,250 for 27 work-months, $15,000 for three HMP inventories, and $5,000 for maintenance of projects beginning in FY 1984.

Variable expenses that may occur during the first year of implementation for each HMP will include costs for horse and burro removal and/or cost of large catchment construction. Budgeting for these expenses in the first year of HMP implementation may be a necessity so horse and burro conflicts and water shortages will not hinder the establishment and growth of bighorn populations.

Based on the estimated fixed annual expenses and the variable but unavoidable expenses for horse and burro removal and water catchment construction, a budget of $310,000 for each fiscal year will allow completion of the 26 HMP's in the first and second priority groups by FY 1999.

Completion of these HMP's should be very rewarding. Since water appears to be a major limiting factor for bighorn, population increases following HMP development were based on water consumption. Assuming large catchments are replenished every third year, a very conservative estimate indicates desert bighorn numbers in the Las Vegas District could increase by more than 400 percent or by 9,821 animals.

This increase would be equivalent to an average bighorn density of 4.1 sheep per square mile of sheep habitat in the district. This goal may be unattainable due to unavoidable conflicts. However, some ranges in Nevada do support higher sheep densities; and, as a result, the goal is practical.

Manpower needs for completion of this cooperative action plan call for 27 work-months of work annually. This will require the work of two biologists yearlong and part-time efforts from three other biologists. One full-time position will have to be created to help handle this workload.

SUMMARY AND CONCLUSIONS

The Las Vegas District manages lands which support 53 percent of the desert bighorn in Nevada. The 2,265 sheep inhabit 19 mountain ranges in the district. Historically, sheep inhabited 29 other areas in the district; and six areas, previously unoccupied by bighorn, appear to have potential to support bighorn.

A general description of the district's bighorn habitat and of the populations of sheep using the habitat was presented.

To evaluate the potential for expanding bighorn numbers and expanding, improving, or protecting bighorn habitat in the district, conflicting land uses, habitat deficiencies, and means of increasing sheep numbers were investigated.

Past, current, and potential conflicting land uses were considered in all 54 bighorn habitats including 19 current, 29 historical, and six potential habitats. Conflicts were rated subjectively since the impact of nearly identical land uses can vary between habitats.

Livestock conflicts were rated based on an analysis of several factors including location of dry season livestock concentration areas, the location of crucial bighorn habitat, competition for water, and the number, dates, and types of licensed livestock use. Analysis of horse and burro conflicts involved a subjective study of horse and burro numbers and the overlap between horse and/or burro areas and bighorn areas.

The location and intensity of activity related to mining, powerline and communication site construction and maintenance, competitive ORV activity, and other recreational activities were considered. These conflicts were rated, too.

Vegetative deficiencies on each of the 54 bighorn ranges were considered to be minimal if competition for forage and water is not detrimental. Only nine historical ranges and one potential range appear to have marginally adequate escape cover. All other ranges have good escape cover. The availability of water is inadequate in all but the current habitat on Lone Mountain. There is potential to increase water throughout the other ranges.

Bighorn populations could be increased in the district by reintroducing sheep into historical and potential ranges. These new populations as well as present populations could be enhanced by implementing habitat improvement and competition reduction projects. Habitat improvements include increasing water availability by developing springs and constructing water catchments with storage capacities of 5,000 to 80,000 gallons. Removal of pinyon-juniper cover to increase the availability of grass for bighorn is also planned. Competition can be reduced by eliminating unauthorized horses and burros from sheep habitat and by erecting gap fences to reduce or eliminate livestock, horse, and burro use of forage allocated to wildlife.

Conflicts, habitat characteristics and deficiencies, opportunities for increasing bighorn numbers, and BLM and NDW planning were considered for each bighorn range. Following this analysis, several ranges were combined and 38 possible Wildlife

Habitat Areas (WHA's) were proposed. These WHA's were placed in one of three priority groups for Habitat Management Plan (HMP) development. A time framework for developing HMP's for the WHA's in the first and second priority groups was outlined.

Development of 23 new HMP's, revision of one completed HMP, and implementation of 23 new and 3 completed HMP's will cost approximately $6,121,250. If budgetting provided $310,000 annually, beginning in fiscal year 1981, the first and second priority HMP's could be fully implemented in 20 years. Although limitations to bighorn population densities may be encountered due to unavoidable conflicts and a scarcity of forage, this plan seeks to increase bighorn densities in the district to at least 4.1 sheep per square mile on each sheep range. If the cooperative action plan is successful, bighorn numbers could increase by more than 400 percent or by 9,821 animals.

Obviously, there is a tremendous potential and opportunity to increase the numbers of the majestic desert bighorn in southern Nevada. The abundance of suitable habitat has been documented and a good base for implementing a bighorn project has been presented. This aggressive plan, if appropriately funded, could provide an excellent example of conscientious, multiple-use land management and interagency planning and action. These results would increase the credibility of the Las Vegas District and the Bureau of Land Management in the West.

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ESMARALDA PLANNING UNIT

NELLIS AIR FORCE RANGE

NEVADA TEST SITE

DESERT GAME RANGE

GALIENTE PLANNING UNIT

VIRGIN VALLEY PLANNING UNIT

STATELINE PLANNING UNIT

MAP ONE

LAS VEGAS DISTRICT DESERT BIGHORN SHEEP REPORT

PLANNING UNITS AND MOUNTAIN RANGES
IN THE LAS VEGAS DISTRICT

LANDS MANAGED BY OTHER FEDERAL AGENCIES

PLANNING UNIT BOUNDARIES

J. HOWELL (NOV. 1979)

MAP TWO

LAS VEGAS DISTRICT DESERT BIGHORN SHEEP REPORT

BIGHORN DISTRIBUTIONS, SEASONAL USE AND CRUCIAL AREAS, AND MIGRATION ROUTES

LANDS MANAGED BY OTHER FEDERAL AGENCIES

BIGHORN DISTRIBUTION ON DISTRICT LANDS

CURRENT DISTRIBUTION

HISTORICAL DISTRIBUTION

POTENTIAL DISTRIBUTION

SEASONAL USE AND CRITICAL AREAS IN CURRENT HABITAT

FALL, WINTER AND SPRING USE AREAS

CRITICAL SUMMER USE AREAS

MIGRATION ROUTES

CURRENT MIGRATION ROUTES

HISTORICAL MIGRATION ROUTES

NELLIS AIR FORCE RANGE

NEVADA TEST SITE

U.S.F.&W.S. DESERT GAME RANGE

J. HOWELL (NOV. 1979)

NELLIS AIR FORCE RANGE

NEVADA TEST SITE

U.S.F.&W.S.
DESERT GAME RANGE

MAP THREE

LAS VEGAS DISTRICT DESERT BIGHORN SHEEP REPORT

LIVESTOCK SUMMER CONCENTRATION AREAS IN BIGHORN HABITAT

- LANDS MANAGED BY OTHER FEDERAL AGENCIES

BIGHORN DISTRIBUTION ON DISTRICT LANDS

- CURRENT DISTRIBUTION
- HISTORICAL DISTRIBUTION
- POTENTIAL DISTRIBUTION

LIVESTOCK SUMMER CONCENTRATION AREAS

- IN CURRENT BIGHORN HABITAT
- IN HISTORICAL BIGHORN HABITAT
- IN POTENTIAL BIGHORN HABITAT

J. HOWELL (NOV. 1979)

MAP FOUR

LAS VEGAS DISTRICT DESERT BIGHORN SHEEP REPORT

HORSE AND BURRO AREAS IN BIGHORN HABITAT

LANDS MANAGED BY OTHER FEDERAL AGENCIES

BIGHORN DISTRIBUTION ON DISTRICT LANDS

CURRENT DISTRIBUTION

HISTORICAL DISTRIBUTION

POTENTIAL DISTRIBUTION

HORSE AND BURRO AREAS

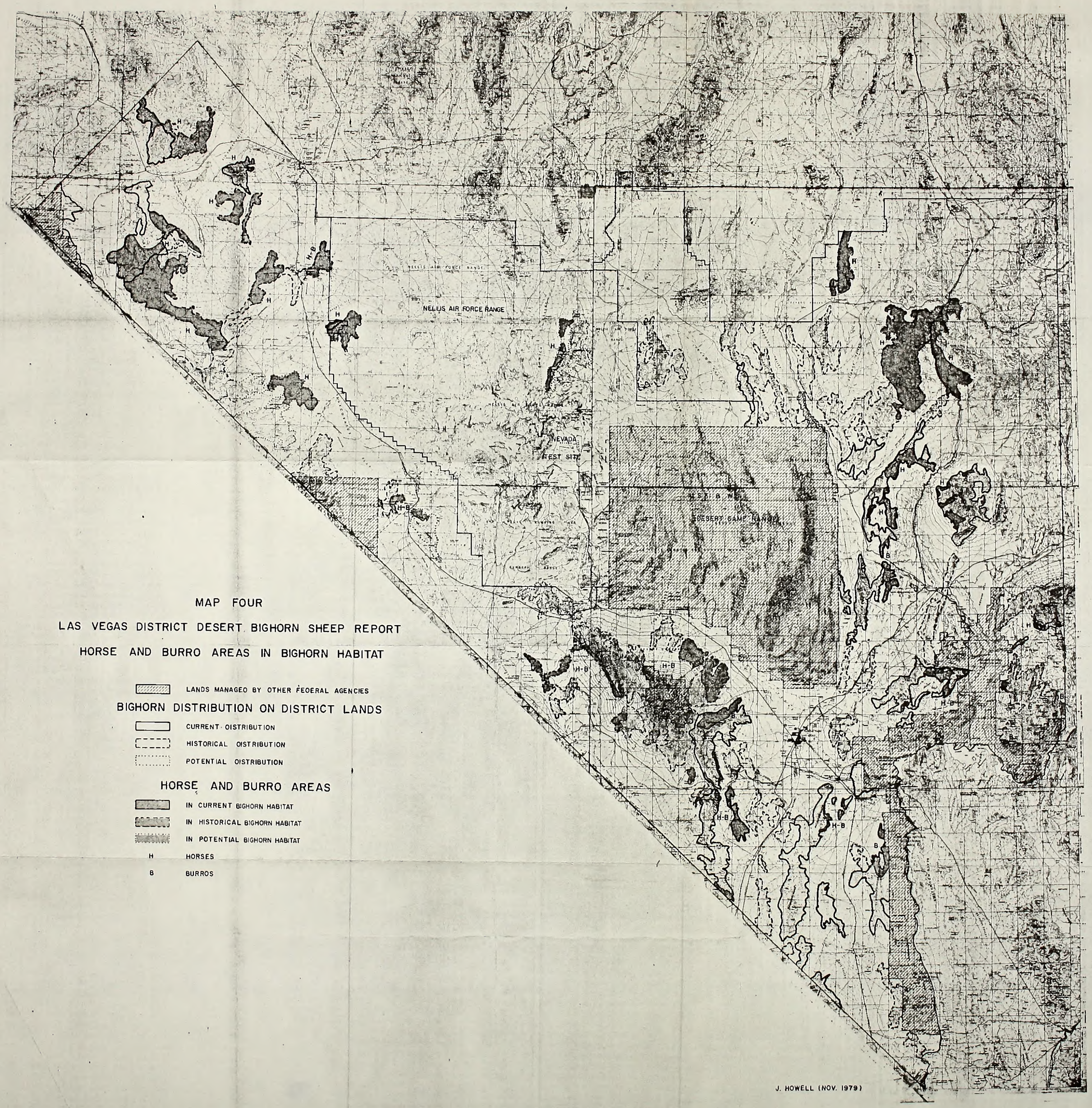
IN CURRENT BIGHORN HABITAT

IN HISTORICAL BIGHORN HABITAT

IN POTENTIAL BIGHORN HABITAT

H HORSES

B BURROS



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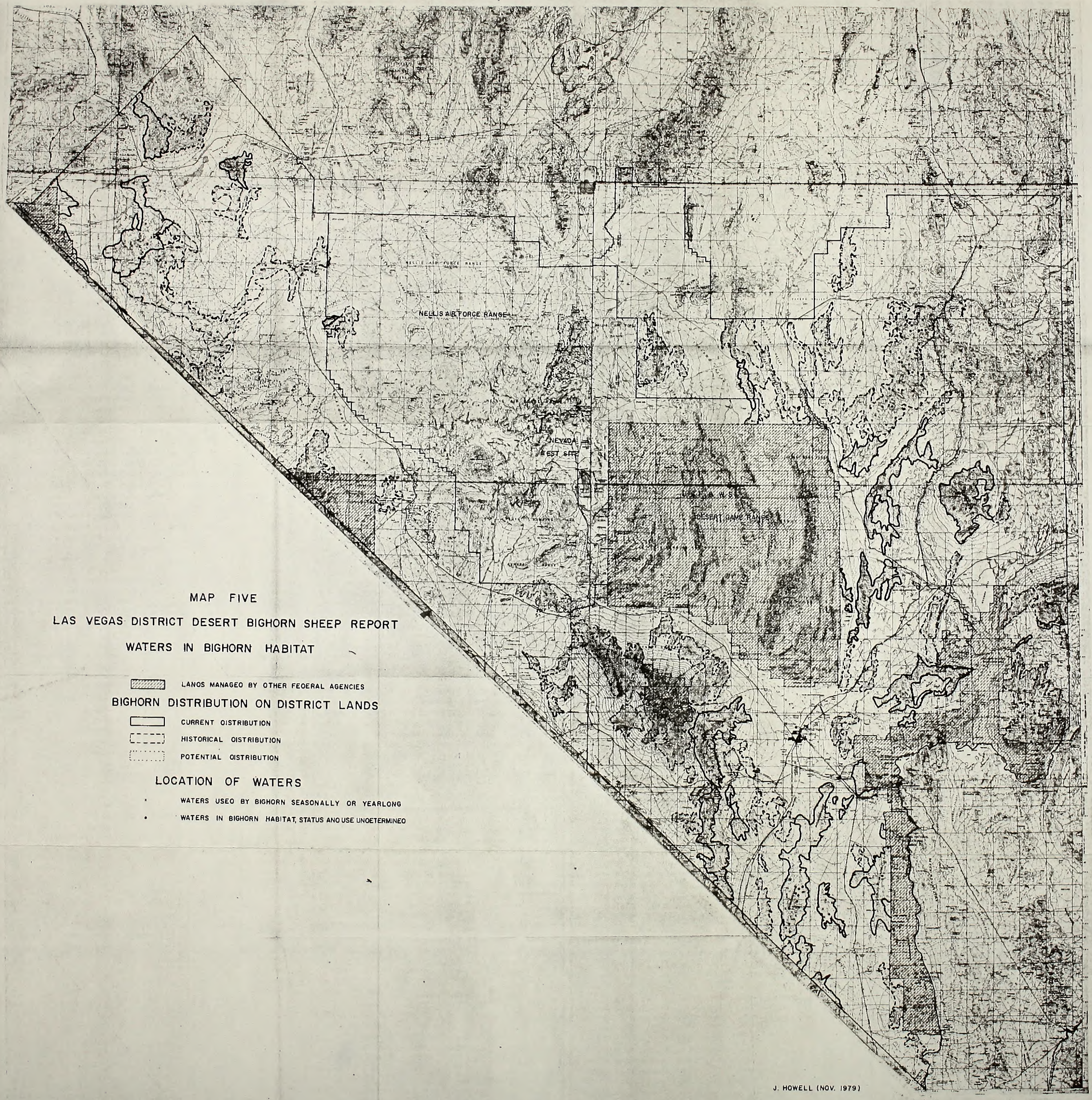

MAP FIVE

LAS VEGAS DISTRICT DESERT BIGHORN SHEEP REPORT

WATERS IN BIGHORN HABITAT

LANDS MANAGED BY OTHER FEDERAL AGENCIES

BIGHORN DISTRIBUTION ON DISTRICT LANDS

CURRENT DISTRIBUTION

HISTORICAL DISTRIBUTION

POTENTIAL DISTRIBUTION

LOCATION OF WATERS

WATERS USED BY BIGHORN SEASONALLY OR YEARLONG

WATERS IN BIGHORN HABITAT, STATUS AND USE UNDETERMINED

J. HOWELL (NOV. 1979)